ACIDIC LEACHING OF PODZOLIC SOILS FROM THE PRECAMBRIAN SHIELD, ONTARIO, CANADA

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ABSTRACT

Three experiments using five Bf and Bhf podzol horizons from the Precambrian Shield, Ontario have demonstrated that the Bf horizons are well buffered against extreme mineral acidity by the dissolution of an oxalate extractable aluminum fraction, either an amorphous aluminum tri-hydroxide or silicate. In contrast, pyrophosphate extractable aluminum from the organic rich Bhf horizon was also important. The equilibrium aluminum concentration of the Bhf horizon was also substantially lower than those of the Bf horizons, which were similar to aluminum concentrations in equilibrium with gibbsite.

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INTRODUCTION

A previous experiment (LaZerte and Findeis 1994) involving the acid leaching of Plastic Lake B horizon soil has demonstrated that an amorphous aluminum tri-hydroxide is the most likely source of inorganic aluminum. There was little evidence for leaching from organic aluminum or hydroxy-interlayer vermiculite. In addition, it was shown that fluoride leaching was highly dependent upon the onset of inorganic aluminum leaching. To verify and expand these results, new experiments were designed using four additional podzolic soils from Harp Lake (Chaffey Township near Huntsville, Ontario), Turkey Lakes (Norberg Township near Sault St. Marie, Ontario), Kirkwood (Wells Township near Sault St. Marie, Ontario) and Hawkeye Lake (Fowler Township near Thunder Bay, Ontario), in addition to the original Plastic Lake podzol (Sherborne Township near Dorset, Ontario) (Figure 1).

In addition, the experimental design was modified to permit a higher, more natural experimental pH (3 rather than 2 as used in the first experiment). To accomplish this, it was necessary to dramatically reduce the soil/water ratio so that statistically significant amounts of aluminum could be removed from the bulk soil despite the higher pH of the eluent. This was best accomplished in experiment #3 where small amounts of soil (10 g) were mixed with 500 mL of solution and then centrifuged. However, experiment #3 provides little detail concerning the early neutralization of acidity by base cations and the pattern of fluoride leaching, both of which provided useful insights in experiment #1. Experiment #2 provides this information for the four additional podzolic soils and includes a comparison between the A and B horizons of three of the locations.

SOIL SAMPLE SITES AND PREPARATION

Soil from five locations throughout Ontario was collected and prepared to be used in this experiment (Figure 1). Preparations included drying, sieving and weighing soil samples. Soil from the B horizons of Harp and Plastic Lake watersheds was collected at an earlier date for use in previous experiments. The soil was dried on clean, plastic lined trays in a

drying oven at 30 to 35 °C until all moisture was removed. "A" horizon soils from these watersheds were allowed to air dry as were the soils from Hawkeye, Kirkwood and Turkey Lake watersheds.

In experiment #3 all soils were passed through a 500 micron sieve after drying. Larger soil aggregates were lightly broken up with a mortar and pestle but any mineral fragments too large to pass through the sieve were discarded. In experiment #2 Hawkeye Lake, Turkey Lake and Kirkwood Lake samples were only passed through a 2 mm sieve. The background chemistry of the soils is summarized in Table 1.

METHODS AND RESULTS EXPERIMENT #2

In the first experiment (LaZerte and Findeis 1994), 1400 grams of soil was added to each of nine coring tubes. Two of the tubes were used as controls and had only distilled water added to them. Two more tubes had a cation solution added while another two had a pH solution added. The final three tubes had both pH and cation solutions added. Results of analysis on the leachate showed that only the pH solution had an effect on the amount of aluminum leached. After completion of the experiment, the soil in each core was sectioned into ten equal parts and these were submitted for analysis. Results showed that most of the aluminum leached came from the top 10% of the acid treated cores. In the bottom part of the acid treated core, oxalate extractable aluminum was precipitated but DCB extracted aluminum was removed. As well, the continuous addition of water to the soil in the cores had caused the soil to become compacted.

Based on the experience with the previous experiment several changes were made in the design of experiment #2. Ninety mm Buchner funnels were used in place of the coring tubes; 250 grams of soil was added to each funnel. Each funnel was mounted on a 1 Litre Erlenmeyer flask using a neoprene stopper with a single hole drilled through it. A 90 mm Teflon filter was used to cover the holes in the bottom of the Buchner funnel to prevent soil

loss. Teflon filters were also used on top of the soil samples to prevent disturbance of the soil when the solutions were added to them.

After an initial wetting, 250 grams of soil held approximately 50 mL of water. Solutions were drawn into the soil using a vacuum pump. They remained for one hour, after which they were removed with the vacuum pump. Approximately 350 mL of leachate was required for a complete range of analysis. The process was repeated 8 times over a period of two days in order to collect enough water for analysis. Since samples had to be stored overnight before enough water was collected, sub-samples for metals analysis were removed daily and acidified. All samples were stored at 4 ° C until analysis.

A total of 21 Buchner funnels were set up for the experiment. Each sample of soil had one funnel for use as a control which had only distilled water added to it. "A" horizon soils had one funnel which had a pH solution added to it as a treatment. "B" horizon soils had the treatments done in duplicate (Table 2). Control solutions contained 1 mMole Cl/Litre as $CaCl_2$. Treatment solutions were made by adding 1 mMole/Litre of hydrochloric acid to reduce the pH to 3.0. Solutions were made fresh daily or as required.

Results of the daily chemical analysis are plotted in Figure 2. Table 3 shows the mean value of each parameter for the last 20 samples while the total amount leached during the entire experiment is presented in Table 4.

After the leaching portion of the experiment was completed, soil was removed from the funnels, dried and submitted for analysis (Janhurst 1991). Results of the soil analysis are presented in Table 6.

DISCUSSION EXPERIMENT #2

The Plastic Bf1 horizon, as well as the Harp and Kirkwood Bf1 horizons, behaved similarly under pH 3 treatment to the Plastic Bf1 horizon under pH 2 treatment, previously reported

in experiment #1 (LaZerte and Findeis 1993). There was an initial phase of cation leaching that buffered the pH, followed by a rapid rise in inorganic aluminum levels to a plateau. Fluoride rose rapidly at the onset of aluminum release, but then decayed to relatively low levels. The Hawkeye Bf1 horizon behaved similarly, with the exception that it took longer for the base cations to be leached, pH to drop and aluminum to reach its plateau. As with the others, fluoride followed the aluminum and then dropped. Given the relatively high exchangeable base cation content of the Hawkeye soils (0.02 meq/g; Table 1) relative to the other Bf1 horizons, this is not unexpected. The mean final pH of the pH 3 treatment draining these soils was 4.2-4.3 (Table 3) which, as in experiment #1, is close to the expected pH (4.28) of a pH 3 solution brought into equilibrium with amorphous gibbsite with a pK of -9.35. Computed saturation indicies (log (ion activity product/equilibrium constant)) for Hem's amorphous gibbsite were also close, -0.2 to -0.6, with the saturation index for May's synthetic gibbsite (pk = -8.11) between 0.6 to 1.0, effectively bracketing the observed solubilities. Imogolite was highly undersaturated (S.I. = -3 to -4; see LaZerte and Findeis 1994, for references).

The Turkey Lake Bhf1 horizon was distinctively different from the four others, with the highest organic carbon content, highest extractable iron and aluminum values and highest exchangeable aluminum values. This horizon exhibited a steady drop in pH under the pH 3 treatment, a steady rise in aluminum and slow release of calcium until close to the termination of the experiment. Fluoride was also slowly released and appeared to be declining toward the end of the experiment. In general the patterns observed in the podzolic Bf1 horizons are much less pronounced in this organic rich Bhf1 horizon. The mean final pH of the pH 3 treatment draining this soil was about 3.8 (Table 3), substantially lower than the Bf1 horizons, indicating that some process in addition to aluminum dissolution (perhaps dissolved organic acidity) was buffering the pH. The saturation indicies with respect to Hem's gibbsite were less than -1 and declining, while those with respect to May's gibbsite started at zero but dropped to less than -1 by the end. Imogolite was even more undersaturated. Undersaturation with respect to gibbsite in organic rich soil horizons has been reported elsewhere (see references in LaZerte and Findeis 1994).

The Harp Ah horizon behaved similarly to the Turkey Lake Bhf1 horizon under the pH 3 treatment, and had very similar organic carbon content and mean final pH and relatively high extractable iron and aluminum and exchangeable aluminum as well. One difference was that fluoride levels were higher than the Turkey Bhf1 horizon and increased throughout the experiment. Relative to the Harp Ah horizon, the two Ae horizons (Plastic and Turkey) were characterized by relatively low mean final base cation and aluminum levels (Table 3), presumably a consequence of their extremely low levels of exchangeable base cations and extractable aluminum (Table 1). Mean final pHs under the pH 3 treatment were also the lowest (3.25-3.36) for these two soils (Table 3), and both soils were very undersaturated with respect to any form of gibbsite or Imogolite.

As mentioned earlier, experiment #2 had an insufficient soil to water ratio at the experimental pH to leach statistically significant amounts of aluminum from the soils of the acid treatment. For example, taking the variance of the control to be the variance of the two treatments (averaged over all soils and normalized to the mean), the ALEDI of the PCB control is 7.5 $\pm$0.4 (s.d.) versus the PCB treatment of 7.8 $\pm$0.4; similarly the ALEOX of the PCB control is 12.9 $\pm$2.3 versus the treatment of 14.3 $\pm$0.3. In some cases there may even have been small increases in ALEOX and ALEPY under acid treatment, however, the statistical significance is marginal, and both experiment #1 and experiment #3 clearly show just the opposite trend. In general, random differences between treatment replicates masked any changes in bulk soil properties.

METHODS AND RESULTS EXPERIMENT #3

In experiment #2 the amount of soil was decreased from 1400 to 250 grams. As well, Buchner funnels were used in place of coring tubes. These changes were made in an effort to decrease compaction and increase the percentage of aluminum leached from the soil samples. Although the new setup addressed the compaction problem, a much higher ratio of eluent to soil sample was required to leach a greater percentage of the aluminum from the soil.

Only B horizon soils, from the same locations as in the previous experiment were used in experiment #3. Four sub-samples of ten grams from the soil of each watershed (total of 20 samples) were added to 500 mL size centrifuge bottles. Two samples of each soil became control samples, the other two treatment. Solutions used were the same as the previous experiment. Control solutions contained 1 mMole Cl/Litre as $CaCl_2$, treatment solutions 1 mMole HCl/Litre. Solutions were made fresh daily or as required.

After weighing each bottle with soil samples, control or treatment solution was added to bring the total weight to 550 grams ($\pm$ 0.2 g). Samples were shaken to ensure complete mixing of sample and solution. Shaking was repeated at least twice more during the next 24 hours. After 24 hours of contact time samples were placed in a centrifuge for 15 minutes at 2500 rpm. After centrifuging, as much supernatant as possible was aspirated into a plastic flask without disturbing the soil sample. Two 40 mL aliquots were poured off for analysis. A third aliquot was used for pH analysis (Table 7). The remainder of the supernatant was discarded. This procedure was repeated a total of 16 times. Two days of sample were combined for aluminum, silica and fluoride analysis for a total of eight samples. All other parameters were combined and refrigerated at 4 °C until the end of the experiment, and only one submission was made (Table 8). The total mass leached was also calculated and presented in Table 9. Note that missing data points were approximated via linear interpolation to allow calculation of total amounts leached.

Soil used in the experiment was removed from the bottles, dried, weighed and submitted for analysis (Janhurst 1991). On average 97.5% of the soil was recovered after completion of the experiment. Results of the soil analysis are presented in Table 10.

METHODS AND RESULTS EXPERIMENT #3A

Due to a shortage of soil from Hawkeye Lake, only soils from the B horizon of Harp, Plastic, Kirkwood and Turkey Lakes were used in experiment #3A. The methods used in the first part of this experiment were the same as those in experiment #3. Two 10 gram

sub-samples of each soil (8 samples) were added to 500 mL centrifuge bottles. A 1 mMole HCl/Litre solution was added to each bottle to bring the weight of each one to 550 mg. After shaking the samples several times during the next 24 hours they were centrifuged and the eluent was aspirated into a plastic flask. After measuring and recording the pH the samples were discarded. This procedure was repeated 8 times in total, leaving soil in the same condition as the midway point of experiment #3.

At the eighth repetition only 50 mL of solution was removed from each bottle. The remainder of the solution was allowed to remain in contact with the soil until the next sub-sampling date when a further 50 mL was removed. Samples were shaken twice daily and cetrifuged before each sub-sampling. In total, eight 50 mL subsamples were removed on days 0, 1, 2, 4, 8, 16, 32 and 64. Results of the analysis performed on each sub-sample are shown in Figure 3.

DISCUSSION EXPERIMENT #3 AND #3A

In the soil column experiments #1 and #2 aluminum levels in solution increased dramatically as pH dropped during the acid treatment in the low organic carbon Bf1 horizons and then reached a plateau apparently dictated by amorphous gibbsite solubility. However, in experiment #3, aluminum levels in the supernatant declined steadily during the series of centrifugations (Table 7) and samples were never close to saturation with respect to any form of gibbsite. Apparently amorphous gibbsite equilbrium could never be reached in experiment #3 because of the extremely low soil/solution ratio. The decline in aluminum released over time was most likely the result of a reduction in reactive surface area of amorphous gibbsite. Despite slow release rates, equilibration with amorphous gibbsite would have eventually been reached if contact time were increased, as is demonstrated by the long term equilibration experiment (#3a).

In experiment #3a both pH and aluminum levels plateau after 16-32 days (Figure 3), and the saturation index with respect to May's synthetic gibbsite approaches zero: -0.1, -0.3, -0.7

for Plastic, Kirkwood and Harp, respectively. Hem's amorphous gibbsite is always undersaturated (-1.3 to -2.0). The organic Turkey Bhf1 soils are again the exception: its aluminum levels do seem to plateau after 16 days but they never reach saturation with respect to gibbsite or imogolite. The temporal behaviour of sodium, magnesium and silica is quite different from pH and aluminum: they do not plateau, but rise steadily throughout the experiment. Because of silica's steady rise, the saturation index of imogolite eventually passes zero for Plastic and Kirkwood, reaching 0.38 and 0.06, respectively. Harp reaches -0.83.

The pronounced difference in temporal behaviour of aluminum and silica dissolution in experiment #3a shows that congruent dissolution of some aluminum silicate (amorphous or otherwise) is not responsible. More likely, amorphous gibbsite dissolution or incongruent dissolution of an amorphous aluminum silicate is responsible for aluminum dissolution. The source of silica is not the weathering of primary minerals as the base cation levels are not sufficient to explain it; even the rather high release rates of calcium from the Harp Bf1 soil can only account for about 3 mg/L silica, if anorthite dissolution is assumed. Rather, the dissolution of an amorphous silicate or aluminum silicate (see below), or possibly even quartz, must be responsible for most of the silica released.

Returning to experiment #3, the total mass of aluminum, fluoride and silica leached into solution can be determined from either the bi-daily measurements (Table 7) or from the final combined water samples (Table 9). In all cases, the two numbers agree reasonably well. In addition, the mass of aluminum lost by the acid treatment soil relative to the controls as determined by the oxalate extraction is in reasonable agreement with the relative amount lost in solution, although the Harp estimate is significantly higher and the Hawkeye estimate significantly lower:

Relative Total Aluminum Loss (Treatments-Controls; mg (95% C.I.))

	Oxalate Ext. from Table 10	Leachate from Table 7	Leachate from Table 9
Harp	37 (5)	30 (1)	28 (0)
Plastic	31 (7)	38 (1)	36 (4)
Turkey	32 (8)	23 (2)	23 (0)
Kirkwood	37 (2)	34 (2)	34 (2)
Hawkeye	20 (1)	24 (2)	23 (0)

As oxalate only extracts amorphous and organic aluminum, not primary mineral aluminum, this confirms the conclusion from experiment #1 and #3a that primary mineral weathering is not a major component of the acid leaching of aluminum in these soils.

The oxalate extractable silica results confirm this conclusion (see below) and also suggest that acid leaching does not substantially enhance the release of silica from quartz (as oxalate extractable amorphous silica accounts for all the silica released), a conclusion we were unable to make in experiment #1. However, the oxalate extractable silica errors are still fairly large and thus small differences, if present, cannot be identified.

Estimates of Total Silica Loss (Treatments-Controls; mg (95% C.I.))

	Oxalate Ext. from Table 10	Leachate from Table 7	Leachate from Table 9
Harp	3 (2)	6 (0)	6 (0)
Plastic	11 (4)	6 (0)	7 (0)
Turkey	1 (1)	1 (0)	1 (0)
Kirkwood	9 (3)	6 (1)	7 (0)
Hawkeye	8 (1)	6 (2)	8 (0)

The organic rich Turkey Bhf1 soil was distinguished by the lowest silica leachates and lowest oxalate extractable silica. It also had the lowest enhancement of silica leaching by the acid treatment.

Oxalate extractable amorphous aluminum consists of organic and inorganic fractions. By subtracting the organic fraction (ALEPY) we can estimate the aluminum derived from the inorganic amorphous aluminum tri-hydroxides and silicates. It is apparent below that only for the organic rich Turkey Bhf1 soil was organic aluminum a dominant source for the acid treatment relative to the control. The Plastic Bf1 results are in close agreement with those of experiment #1, even though the treatment pH in experiment #3 was 3 rather than 2.

Estimates of Aluminum Sources (Treatment-Controls; mg (95% C.I.))

	Total Oxalate from Table 10	**Pyrophosphate from Table 10**	**Oxal.-Pyroph. Leachate from Table 10**
Harp	37 (5)	9 (1)	28 (6)
Plastic	31 (7)	6 (6)	26 (13)
Turkey	32 (8)	16 (4)	16 (11)
Kirkwood	37 (2)	5 (1)	32 (3)
Hawkeye	20 (1)	2 (8)	22 (8)

The inorganic fraction of oxalate extractable aluminum can be derived from amorphous aluminum tri-hydroxides or silicates. An Al to Si molar ratio of around 1.6-2.8 (see references in LaZerte and Findeis 1994) can be used as an indicator of the leaching of allophane or imogolite Al-Si compounds:

Estimates of Al/Si (Treatments-Controls; (~95% C.I.))

	Oxalate Ext. from Table 10	Leachate from Table 7	Leachate from Table 9
Harp	8 (6)	5 (0)	5 (0)
Plastic	2 (1)	6 (0)	6 (1)
Turkey	13 (12)	37 (4)	34 (12)
Kirkwood	4 (1)	5 (0)	5 (0)
Hawkeye	3 (1)	4 (0)	3 (0)

In this experiment, molar Al to Si ratios in the leachate (acid treatment relative to the control) were all relatively high with Turkey having a ratio of ~35. Ratios in the oxalate extractable fraction (acid treatment relative to the control) were lower and in the range of allophane leaching except for the organic rich Turkey Bhf1 soil. In experiment #1, the Plastic soil had similar ratios of 2.0-2.5 for the oxalate fraction and 4 for the leachate. Although it is clear that allophane is an unimportant source of Al for the Turkey Bhf1 soil leached under acidic conditions, it is may be important for the other soils.

LaZerte and Findeis (1994) argued that the oxalate and dithionite extractions may be measuring two separate aluminum fractions in the Plastic Bf1 soils: amorphous aluminum silicates and aluminum tri-hydroxides respectively. Similarly, for both the Plastic and Hawkeye soils in this experiment, if the dithionite extracted aluminum and oxalate extracted aluminum are added together, a closer approximation to the total leached aluminum measured in solution is obtained. However, for the other three soils, the approximation becomes worse. Consequently, this hypothesis is not generally supported.

CONCLUSIONS

The experiments reported here (#2, 3, 3a) confirm and expand upon the earlier experiments (#1) of LaZerte and Findeis (1994). In particular, the differences in treatment pH (2 versus

3) used does not appear to be important to the conclusions, suggesting that they are generally robust. The expansion of the experiment to podzolic soils from five different locations on the Precambrian Shield in Ontario also confirmed the general applicability of our conclusions. The organic carbon rich Turkey Bhf1 soil provided a useful contrast to the four Bf1 horizons and confirmed other studies on soils of this nature (see references in LaZerte and Findeis 1994).

In general, podzolic Bf horizons on the Precambrian Shield in Ontario appear to be well buffered against mineral acidity by the dissolution of an oxalate extractable aluminum fraction, either an amorphous aluminum tri-hydroxide or silicate. Organic aluminum as extracted by pyrophosphate is not as important in Bf horizons but becomes more important in Bhf horizons.

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REFERENCES

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reanalyzed the B horizon samples and provide the correct numbers below:

Location	Harp		Plastic		Turkey		Kirkwood	Hawkeye
Abbrev.	HPA	HPB	PCA	PCB	TYA	TYB	KDB	HEB
ALEOX mg/g	-	8.5	-	19.3	-	9.0	12.4	6.3
SIEOX mg/g	-	1.9	-	5.3	-	0.1	2.9	1.2

TABLE 1. SOIL SAMPLE DETAILS AND CHEMISTRY

Location	Harp		Plastic		Turkey		Kirkwood	Hawkeye
Latitude	45°23'		45°11'		47°03'		46°25'	48°41'
Longitude	79°07'		78°50'		84°24'		83°23'	89°27'
Abbreviation	HPA	HPB	PCA	PCB	TYA	TYB	KDB	HEB
Site	CD4	CD3 CD4	1-11	1-11 1-12 3-14				BWZT BWT
Horizon	Ah	Bf1	Ae	Bf1	Ae	Bhf1	Bf1	Bf1
Depth cm.	0–4	16–31 13–33	0–10	9–34 7–30 8–25	0–4	4–7	2–17	5–20 5–33
Drying method	air	oven at 30 to 35 deg C.	air	oven at 30 to 35 deg C.	air	air	air	air
Comments		heavy LFH layer	equal amts. from each site	soil in pockets of varying depth	equal amts. from each site			600 g. BWZT 432 g. BWT
ALECA mg/g	0.010	0.003	0.018	0.004	0.015	0.036	0.003	0.001
ALEDI mg/g	4.23	4.67	0.400	8.0	0.300	6.63	6.07	4.40
ALEOX mg/g	18.4	13.5	2.87	15.3	2.50	24.4	20.7	8.10
ALEPY mg/g	5.13	4.53	1.00	6.27	0.700	7.37	5.13	3.65
ALESC mequiv/g	0.015	0.003	0.020	0.004	0.021	0.045	0.003	0.002
CAESC mequiv/g	0.025	0.004	0.004	0.001	0.008	0.012	0.005	0.020
CEC mequiv/g	0.046	0.007	0.025	0.006	0.032	0.060	0.009	0.029
CLAY mg/g	123	23.3	36.7	10.0	60.0	113	13.3	30.0
FEEDI mg/g	11.6	6.07	2.27	8.40	2.63	22.6	8.83	13.8
FEEOX mg/g	15.3	6.30	2.93	4.37	2.30	47.0	5.27	2.60
FEEPY mg/g	8.03	2.70	1.13	2.20	1.00	18.0	3.17	2.05
KKESC mequiv/g	0.0019	0.0003	0.0005	0.0005	0.0009	0.0011	0.0004	0.0017
MGESC mequiv/g	0.0029	0.0001	0.0009	0.0001	0.0016	0.0020	0.0004	0.0050
MNEDI mg/g	0.337	0.147	0.000	0.017	0.010	0.040	0.227	0.030
MNEOX mg/g	0.700	0.103	0.003	0.000	0.000	0.027	0.160	0.000
MNEPY mg/g	0.243	0.040	0.000	0.000	0.000	0.013	0.053	0.000
NNTKUR mg/g	2.97	0.800	0.700	1.20	1.37	3.47	1.03	0.550
ORGC mg/g	57.0	15.3	18.3	31.5	29.4	60.0	21.4	12.5
PHECA	4.27	4.66	3.61	4.58	3.30	3.81	4.69	4.98
PHEW	4.85	5.32	4.25	4.98	3.92	4.25	5.38	5.56
SAND mg/g	507	770	520	570	393	490	840	660
SIEOX mg/g	0.733	1.30	0.400	2.07	0.300	1.67	1.97	1.40
SILT mg/g	370	203	440	417	543	397	143	315
SSO4AD mg/g	0.031	0.058	0.012	0.569	0.013	0.052	0.151	0.036
SSO4EW mg/g	0.014	0.010	0.010	0.022	0.014	0.017	0.021	0.010

Table 2 - Treatment Schedule (Experiment #2)

Soil Sample	Distilled Water (Control)	HCL Treatment #1 (pH 3.1)	HCL Treatment #2 (pH 3.1)
Harp Lake Ah	X	X	
Harp Lake B	X	X	X
Plastic Lake Ae	X	X	
Plastic Lake B	X	X	X
Turkey Lake Ae	X	X	
Turkey Lake Bhf1	X	X	X
Kirkwood Bf1	X	X	X
Hawkeye Lake Bf1	X	X	X

Table 3 Mean of the last 20 samples (Experiment #2)

SITE	Organic Al	Inorganic Al	Total Al	F	Ammonium	Nitrate	Ca	Mg	Na	K	SO4	Si	DOC	Fe	Mn	pH
HEB-CTRL	0.0186	0.0278	0.0481	0.0082	0.1019	0.0121	0.1846	0.0588	0.0243	0.1210	0.0969	0.5307	1.2989	0.0138	0.0003	6.3005
HEB-TREAT1	0.0079	2.6295	2.8639	0.0934	0.0650	0.0024	0.9457	0.0772	0.0662	0.1773	0.0356	1.4748	0.4386	0.0113	0.0047	4.1925
HEB-TREAT2	0.0083	2.6812	2.8811	0.0947	0.0648	0.0047	1.0345	0.0811	0.0657	0.1780	0.0404	1.5131	0.4585	0.0085	0.0047	4.1955
HPA-CTRL	0.0235	0.0547	0.0663	0.0058	0.0378	0.8644	1.1351	0.1605	0.0442	0.1077	0.2548	0.4011	1.2044	0.0115	0.0117	5.1940
HPA-TREAT1	0.0164	1.6795	1.7672	0.0550	0.2314	0.3755	1.9556	0.0718	0.0625	0.1019	0.0712	0.7203	0.8394	0.1171	0.3124	3.6690
HPB-CTRL	0.0079	0.0179	0.0253	0.0049	0.0587	0.0136	0.0912	0.0198	0.0212	0.0269	0.1432	0.2691	0.5874	0.0053	0.0005	5.7430
HPB-TREAT1	0.0075	3.1207	3.3392	0.0420	0.0669	0.0062	0.5068	0.0678	0.0470	0.0362	0.0786	0.7789	0.5256	0.0280	0.0533	4.2750
HPB-TREAT2	0.0072	3.0605	3.2544	0.0427	0.0627	0.0040	0.5923	0.2435	0.0353	0.0323	0.0640	0.7916	0.4497	0.0128	0.0542	4.2975
KDB-CTRL	0.0060	0.0108	0.0126	0.0026	0.0210	0.0471	0.1321	0.0298	0.0211	0.0198	0.1654	0.1668	0.4612	0.0044	0.0002	5.6785
KDB-TREAT1	0.0090	3.1851	3.3537	0.0196	0.0380	0.0208	0.1292	0.0364	0.0467	0.0291	0.0766	0.9070	0.3332	0.0065	0.0717	4.2190
KDB-TREAT2	0.0058	3.1449	3.3259	0.0194	0.0372	0.0198	0.1236	0.0277	0.0424	0.0266	0.0749	0.8979	0.3232	0.0053	0.0706	4.1970
PCA-CTRL	0.0170	0.0272	0.0442	0.0091	0.1117	0.0097	0.0085	0.0093	0.0452	0.0350	0.0301	0.3655	1.0105	0.0262	0.0003	5.6715
PCA-TREAT1	0.0161	1.4242	1.4198	0.0068	0.1675	0.0067	0.1342	0.1143	0.1435	0.0777	0.0602	0.9621	0.8337	0.0325	0.0041	3.3600
PCB-CTRL	0.0056	0.0387	0.3084	0.0076	0.1330	0.0089	0.0547	0.0623	0.0345	0.0325	0.8910	0.4996	0.6337	0.0820	0.0024	5.1955
PCB-TREAT1	0.0081	3.3030	3.6389	0.0611	0.0832	0.0073	0.1083	0.0781	0.0467	0.0223	0.2113	0.8854	0.6593	0.0670	0.0063	4.2735
PCB-TREAT2	0.0079	3.3229	3.6817	0.0575	0.0785	0.0071	0.0769	0.0322	0.0300	0.0178	0.1941	0.8720	0.5343	0.0616	0.0064	4.2570
TYA-CTRL	0.0237	0.0344	0.0486	0.0043	0.4769	0.4827	0.1331	0.0564	0.0620	0.1209	0.0957	0.3257	1.7325	0.0326	0.0017	5.4295
TYA-TREAT1	0.0174	0.4869	0.5049	0.0076	0.2464	0.0060	0.5035	0.0562	0.1538	0.0984	0.0513	0.7944	1.0870	0.0260	0.0028	3.2475
TYB-CTRL	0.0766	0.1257	0.2265	0.0046	0.5774	0.2891	0.1698	0.0469	0.0255	0.0655	0.2125	0.2444	3.9715	0.0770	0.0077	5.5325
TYB-TREAT1	0.0403	2.1221	2.3042	0.0266	0.4668	0.0080	0.9278	0.0300	0.0677	0.0576	0.0970	0.4641	1.7861	0.0895	0.0151	3.7715
TYB-TREAT2	0.0464	2.2109	2.3980	0.0274	0.4930	0.0058	0.9119	0.0672	0.0858	0.0667	0.1189	0.4704	1.9547	0.0483	0.0126	3.8275

all values except pH in mg/L

Table 4 Total mass leached (Experiment #2)

Site	Organic Al	Inorganic Al	Total Al	F	Ammonium	Nitrate	Ca	Mg	Na	K	SO4	Si	DOC	Fe	Mn
HEB-CTRL	1.589	2.403	5.020	0.355	5.693	0.347	19.881	6.151	2.799	8.871	13.254	41.466	163.395	1.402	0.027
HEB-TREAT1	0.908	66.485	77.509	2.837	5.727	0.104	144.013	21.136	4.146	19.700	7.514	73.824	66.494	1.257	0.247
HEB-TREAT2	0.891	67.088	76.194	2.828	5.821	0.154	149.219	21.950	4.179	20.000	7.855	75.498	72.070	1.118	0.253
HPA-CTRL	1.914	3.660	6.709	0.306	15.567	47.944	54.146	9.546	2.697	13.919	20.401	23.338	149.910	2.694	0.839
HPA-TREAT1	1.414	52.422	56.951	1.763	35.999	34.251	146.672	12.583	3.115	17.582	12.514	34.048	108.680	4.797	9.915
HPB-CTRL	0.614	1.201	3.256	0.211	4.545	0.759	8.080	1.772	1.095	2.840	21.025	26.843	82.166	0.839	0.197
HPB-TREAT1	0.380	127.488	146.863	4.004	4.698	0.484	39.196	4.398	2.200	4.685	5.010	44.998	41.327	1.907	4.536
HPB-TREAT2	0.341	127.640	145.007	3.954	4.549	0.231	40.271	7.868	1.977	4.173	4.577	44.344	40.090	1.319	4.616
KDB-CTRL	0.537	0.818	3.686	0.118	3.155	1.350	10.247	2.372	1.726	2.294	27.927	13.874	41.756	0.367	0.039
KDB-TREAT1	0.709	123.696	139.330	2.216	4.559	0.626	39.556	3.339	2.631	3.792	8.396	37.657	23.139	0.472	2.724
KDB-TREAT2	0.353	124.770	139.737	2.200	4.702	0.617	39.062	3.237	2.592	3.814	8.566	37.614	23.249	0.331	2.710
PCA-CTRL	1.595	2.476	5.143	0.622	8.110	0.329	1.967	1.422	2.911	2.937	7.026	19.638	112.042	2.535	0.060
PCA-TREAT1	1.060	61.199	65.124	1.299	14.832	0.179	29.711	7.472	6.637	6.423	6.031	39.779	72.979	1.970	0.662
PCB-CTRL	0.443	2.506	18.607	0.348	8.762	0.304	6.130	3.555	1.984	5.387	62.826	39.218	52.901	4.641	0.368
PCB-TREAT1	0.508	137.945	169.729	4.626	8.420	0.251	10.471	3.678	2.275	5.836	12.048	54.146	53.625	4.086	0.786
PCB-TREAT2	0.505	140.544	173.976	4.590	7.893	0.223	9.473	2.346	1.649	5.270	11.716	53.571	47.049	3.410	0.784
TYA-CTRL	2.326	3.614	5.587	0.325	20.201	9.982	8.847	3.786	3.751	7.712	9.079	18.443	289.586	3.382	0.074
TYA-TREAT1	1.477	18.215	20.916	0.487	27.534	0.248	54.582	8.303	6.805	11.791	6.830	32.985	190.778	1.895	0.387
TYB-CTRL	6.256	18.031	20.679	0.332	47.666	5.924	12.177	5.222	3.073	9.470	28.567	18.674	555.412	9.378	0.454
TYB-TREAT1	3.460	80.054	87.607	1.206	56.459	0.222	78.799	10.281	4.739	12.279	17.423	25.889	340.581	5.627	1.983
TYB-TREAT2	4.025	84.465	86.189	1.270	56.231	0.187	78.674	10.506	4.918	12.398	17.718	26.380	350.292	4.885	1.855

all values in milligrams

Table 5 Soil analysis parameter codes

Abbreviation	Description
ALECA	Aluminum, Calcium Chloride extractable
ALEDI	Aluminum, Dithionite extractable
ALEOX	Aluminum, Oxalate extractable
ALEPY	Aluminum, Pyrophosphate extractable
ALESC	Aluminum, Sodium Chloride extractable
CAESC	Calcium, Sodium Chloride extractable
CEC	Cation Exchange Capacity
CLAY	Clay, particle size
FEEDI	Iron, Dithionite extractable
FEEOX	Iron, Oxalate extractable
FEEPY	Iron, Pyrophosphate extractable
KKESC	Potassium, Sodium Chloride extractable
MGESC	Magnesium, Sodium Chloride extractable
MNEDI	Manganese, Dithionite extractable
MNEOX	Manganese, Oxalate extractable
MNEPY	Manganese, Pyrophosphate extractable
NNTKUR	Nitrogen, Total Kjeldahl, unfiltered
ORGC	Organic Carbon
PHECA	pH, Calcium Chloride extractable
PHEW	pH, Water extractable
SAND	Sand, particle size
SIEOX	Silicon, Oxalate extractable
SILT	Silt, particle size
SSO4AD	Sulfate, Absorbed & water soluble
SSO4EW	Sulfate, water extractable

Table 6 Soil Chemistry - Experiment #2

ALECA mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.0100	0.0001	0.0121	0.0018	0.0453	0.0029			0.0453	0.0029	0.0332
HPB	0.0029	0.0000	0.0032	0.0003	0.0096	0.0000	0.0099	0.0000	0.0098	0.0002	0.0066
PCA	0.0181	0.0006	0.0120	0.0001	0.0272	0.0020			0.0272	0.0020	0.0152
PCB	0.0040	0.0002	0.0030	0.0010	0.0062	0.0001	0.0057	0.0008	0.0059	0.0005	0.0029
TYA	0.0150	0.0015	0.0110	0.0004	0.0288	0.0007			0.0288	0.0007	0.0178
TYB	0.0357	0.0027	0.0179	0.0010	0.0484	0.0049	0.0512	0.0037	0.0498	0.0034	0.0319
KDB	0.0029	0.0006	0.0032	0.0004	0.0109	0.0007	0.0095	0.0003	0.0102	0.0010	0.0070
HEB	0.0012	0.0000	0.0005	0.0000	0.0235	0.0011	0.0230	0.0026	0.0232	0.0014	0.0227

ALEDI mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	4.233	0.141	4.150	0.100	4.150	0.100			4.150	0.100	0.000
HPB	4.667	0.071	4.100	0.600	3.900	0.400	4.050	0.100	3.975	0.219	-0.125
PCA	0.400	0.122	0.650	0.100	0.500	0.000			0.500	0.000	-0.150
PCB	5.400	5.410	7.500	0.400	7.850	0.500	7.800	0.600	7.825	0.370	0.325
TYA	0.300	0.000	0.500	0.000	0.550	0.100			0.550	0.100	0.050
TYB	6.633	0.071	6.550	0.500	6.200	0.000	6.850	0.100	6.525	0.436	-0.025
KDB	6.067	0.308	5.950	0.700	6.400	0.600	5.950	0.300	6.175	0.436	0.225
HEB	4.400	0.200	4.050	0.300	4.350	0.300	4.550	0.100	4.450	0.200	0.400

ALEOX mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	18.43	1.11	14.45	0.50	16.90	0.00			16.90	0.00	2.45
HPB	13.53	1.34	9.60	0.40	10.05	0.30	10.45	0.10	10.25	0.31	0.65
PCA	2.87	0.67	2.50	0.40	2.15	0.10			2.15	0.10	-0.35
PCB	15.30	1.18	12.90	0.80	14.20	0.20	14.30	0.60	14.25	0.31	1.35
TYA	2.50	0.12	2.10	0.20	2.25	0.10			2.25	0.10	0.15
TYB	24.40	0.49	22.50	1.40	20.35	1.30	23.95	3.10	22.15	2.88	-0.35
KDB	20.73	1.19	13.30	0.80	14.80	2.40	14.10	0.80	14.45	1.28	1.15
HEB	8.10	0.40	6.05	1.10	6.70	0.40	12.05	9.70	9.38	5.80	3.32

ALEPY mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	5.133	0.071	4.650	0.100	5.300	1.000			5.300	1.000	0.650
HPB	4.533	0.071	3.750	0.100	3.750	0.100	4.000	0.000	3.875	0.173	0.125
PCA	1.000	0.122	1.000	0.000	0.800	0.000			0.800	0.000	-0.200
PCB	6.267	0.374	5.600	0.200	6.150	0.100	5.500	0.000	5.825	0.436	0.225
TYA	0.700	0.000	0.550	0.100	0.700	0.000			0.700	0.000	0.150
TYB	7.367	1.070	7.450	0.500	7.250	0.300	7.850	0.300	7.550	0.447	0.100
KDB	5.133	0.141	5.850	0.500	5.750	0.100	5.500	0.000	5.625	0.173	-0.225
HEB	3.650	0.300	3.600	0.000	3.700	0.400	4.150	0.100	3.925	0.357	0.325

Table 6 continued

ALESC milliequiv /g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.0154	0.0006	0.0192	0.0025	0.0314	0.0048			0.0314	0.0048	0.0122
HPB	0.0028	0.0003	0.0032	0.0000	0.0066	0.0006	0.0071	0.0003	0.0068	0.0004	0.0036
PCA	0.0203	0.0025	0.0183	0.0008	0.0228	0.0044			0.0228	0.0044	0.0045
PCB	0.0044	0.0001	0.0036	0.0005	0.0047	0.0038	0.0038	0.0002	0.0043	0.0019	0.0007
TYA	0.0210	0.0007	0.0193	0.0002	0.0225	0.0005			0.0225	0.0005	0.0032
TYB	0.0446	0.0009	0.0265	0.0013	0.0483	0.0017	0.0472	0.0028	0.0477	0.0017	0.0213
KDB	0.0025	0.0001	0.0032	0.0004	0.0068	0.0006	0.0070	0.0014	0.0069	0.0007	0.0037
HEB	0.0018	0.0001	0.0019	0.0001	0.0147	0.0045	0.0112	0.0010	0.0129	0.0032	0.0111

CAESC milliequiv /g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.0253	0.0009	0.0162	0.0015	0.0016	0.0000			0.0016	0.0000	-0.0146
HPB	0.0039	0.0002	0.0023	0.0004	0.0002	0.0001	0.0002	0.0000	0.0002	0.0001	-0.0021
PCA	0.0037	0.0003	0.0041	0.0001	0.0000	0.0000			0.0000	0.0000	-0.0041
PCB	0.0009	0.0002	0.0003	0.0000	0.0000	0.0000	0.0002	0.0001	0.0001	0.0001	-0.0002
TYA	0.0084	0.0002	0.0077	0.0003	0.0002	0.0002			0.0002	0.0002	-0.0075
TYB	0.0124	0.0006	0.0104	0.0017	0.0011	0.0000	0.0011	0.0001	0.0011	0.0001	-0.0093
KDB	0.0054	0.0002	0.0033	0.0002	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	-0.0031
HEB	0.0203	0.0001	0.0187	0.0001	0.0004	0.0001	0.0003	0.0002	0.0003	0.0001	-0.0183

CEC milliequiv /g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.0455	0.0009	0.0370	0.0041	0.0337	0.0047			0.0337	0.0047	-0.0033
HPB	0.0071	0.0005	0.0056	0.0004	0.0069	0.0005	0.0073	0.0004	0.0071	0.0004	0.0015
PCA	0.0254	0.0022	0.0234	0.0010	0.0230	0.0045			0.0230	0.0045	-0.0004
PCB	0.0060	0.0003	0.0038	0.0005	0.0048	0.0038	0.0041	0.0003	0.0044	0.0019	0.0006
TYA	0.0319	0.0005	0.0286	0.0001	0.0228	0.0003			0.0228	0.0003	-0.0058
TYB	0.0601	0.0017	0.0382	0.0004	0.0495	0.0016	0.0485	0.0030	0.0490	0.0017	0.0108
KDB	0.0088	0.0002	0.0067	0.0006	0.0072	0.0006	0.0074	0.0014	0.0073	0.0007	0.0006
HEB	0.0287	0.0007	0.0249	0.0001	0.0151	0.0044	0.0116	0.0012	0.0134	0.0032	-0.0115

CLAY mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	123.3	30.8	110.0	0.0	115.0	10.0			115.0	10.0	5.0
HPB	23.3	28.3	10.0	0.0	10.0	0.0	10.0	0.0	10.0	0.0	0.0
PCA	36.7	7.1	40.0	0.0	40.0	0.0			40.0	0.0	0.0
PCB	10.0	12.2	15.0	10.0	10.0	0.0	15.0	10.0	12.5	5.8	-2.5
TYA	60.0	12.2	60.0	0.0	60.0	0.0			60.0	0.0	0.0
TYB	113.3	18.7	100.0	0.0	90.0	0.0	90.0	0.0	90.0	0.0	-10.0
KDB	13.3	7.1	50.0	40.0	40.0	40.0	20.0	0.0	30.0	23.1	-20.0
HEB	30.0	0.0	45.0	50.0	20.0	0.0	65.0	90.0	42.5	52.0	-2.5

Table 6 continued

FEEDI mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	11.63	0.28	11.90	0.60	11.45	0.50			11.45	0.50	-0.45
HPB	6.07	0.07	5.95	0.50	6.05	0.50	6.30	0.20	6.18	0.30	0.22
PCA	2.27	0.25	2.85	0.70	2.45	0.10			2.45	0.10	-0.40
PCB	8.40	6.16	10.80	0.20	11.45	0.70	11.30	0.60	11.38	0.45	0.57
TYA	2.63	0.07	2.70	0.20	2.85	0.10			2.85	0.10	0.15
TYB	22.60	0.65	22.45	1.50	20.95	0.10	23.65	0.70	22.30	1.83	-0.15
KDB	8.83	0.31	9.00	0.80	9.60	0.80	8.95	0.30	9.28	0.59	0.28
HEB	13.80	0.20	12.85	0.90	13.15	0.70	13.40	0.40	13.28	0.41	0.43

FEEOX mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	15.27	0.67	12.45	0.10	13.80	0.00			13.80	0.00	1.35
HPB	6.30	0.21	4.95	0.10	5.85	0.30	6.40	0.20	6.13	0.40	1.17
PCA	2.93	0.39	2.70	0.40	3.10	0.00			3.10	0.00	0.40
PCB	4.37	0.28	3.35	0.50	4.15	0.30	4.50	0.00	4.33	0.27	0.98
TYA	2.30	0.12	2.20	0.20	2.85	0.10			2.85	0.10	0.65
TYB	46.97	1.95	39.55	0.50	47.70	2.80	50.40	2.40	49.05	2.50	9.50
KDB	5.27	0.07	5.65	0.10	6.15	0.10	6.25	0.90	6.20	0.43	0.55
HEB	2.60	0.20	2.35	0.10	3.05	0.10	3.05	0.10	3.05	0.07	0.70

FEEPY mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	8.033	0.141	7.600	0.200	7.850	0.500			7.850	0.500	0.250
HPB	2.700	0.000	2.450	0.100	2.750	0.100	3.000	0.000	2.875	0.173	0.425
PCA	1.133	0.071	1.100	0.000	1.200	0.000			1.200	0.000	0.100
PCB	2.200	0.245	1.800	0.000	2.400	0.000	2.100	0.000	2.250	0.200	0.450
TYA	1.000	0.000	0.800	0.000	1.000	0.000			1.000	0.000	0.200
TYB	17.967	2.130	17.850	0.900	18.400	0.000	18.600	0.800	18.500	0.400	0.650
KDB	3.167	0.187	3.350	0.300	3.700	0.200	3.550	0.100	3.625	0.145	0.275
HEB	2.050	0.100	1.950	0.100	2.100	0.000	2.250	0.100	2.175	0.111	0.225

KKESC milliequiv /g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.0019	0.0001	0.0008	0.0001	0.0006	0.0001			0.0006	0.0001	-0.0002
HPB	0.0003	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	-0.0000
PCA	0.0005	0.0000	0.0002	0.0000	0.0001	0.0000			0.0001	0.0000	-0.0001
PCB	0.0005	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001
TYA	0.0009	0.0000	0.0003	0.0000	0.0001	0.0000			0.0001	0.0000	-0.0002
TYB	0.0011	0.0000	0.0003	0.0000	0.0002	0.0001	0.0003	0.0001	0.0002	0.0001	-0.0001
KDB	0.0004	0.0001	0.0001	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.0001
HEB	0.0017	0.0002	0.0010	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	-0.0009

Table 6 continued

MGESC milliequiv /g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1 &2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.0029	0.0001	0.0009	0.0000	0.0001	0.0000			0.0001	0.0000	-0.0008
HPB	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PCA	0.0009	0.0000	0.0009	0.0001	0.0001	0.0001			0.0001	0.0001	-0.0008
PCB	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TYA	0.0016	0.0001	0.0013	0.0000	0.0000	0.0000			0.0000	0.0000	-0.0013
TYB	0.0020	0.0002	0.0011	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0001	-0.0011
KDB	0.0004	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001
HEB	0.0050	0.0003	0.0034	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0034

MNEDI mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.337	0.019	0.290	0.040	0.275	0.030			0.275	0.030	-0.015
HPB	0.147	0.014	0.140	0.040	0.115	0.010	0.140	0.020	0.128	0.020	-0.013
PCA	0.000	0.000	0.000	0.000	0.000	0.000			0.000	0.000	0.000
PCB	0.017	0.007	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.010
TYA	0.010	0.000	0.000	0.000	0.005	0.010			0.005	0.010	0.005
TYB	0.040	0.000	0.030	0.000	0.015	0.010	0.015	0.010	0.015	0.007	-0.015
KDB	0.227	0.007	0.185	0.010	0.195	0.010	0.190	0.020	0.193	0.011	0.007
HEB	0.030	0.000	0.010	0.000	0.010	0.000	0.010	0.000	0.010	0.000	0.000

MNEOX mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.700	0.042	0.490	0.000	0.525	0.010			0.525	0.010	0.035
HPB	0.103	0.014	0.080	0.000	0.070	0.000	0.060	0.000	0.065	0.007	-0.015
PCA	0.003	0.007	0.010	0.000	0.000	0.000			0.000	0.000	-0.010
PCB	0.000	0.000	0.000	0.000	0.005	0.010	0.000	0.000	0.003	0.006	0.003
TYA	0.000	0.000	0.000	0.000	0.000	0.000			0.000	0.000	0.000
TYB	0.027	0.007	0.040	0.000	0.010	0.000	0.005	0.010	0.008	0.006	-0.033
KDB	0.160	0.000	0.145	0.010	0.160	0.000	0.175	0.030	0.168	0.017	0.023
HEB	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.010

MNEPY mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.243	0.007	0.215	0.010	0.205	0.010			0.205	0.010	-0.010
HPB	0.040	0.000	0.030	0.000	0.040	0.000	0.040	0.000	0.040	0.000	0.010
PCA	0.000	0.000	0.000	0.000	0.000	0.000			0.000	0.000	0.000
PCB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TYA	0.000	0.000	0.000	0.000	0.000	0.000			0.000	0.000	0.000
TYB	0.013	0.007	0.010	0.000	0.010	0.000	0.010	0.000	0.010	0.000	0.000
KDB	0.053	0.007	0.045	0.010	0.060	0.000	0.070	0.000	0.065	0.007	0.020
HEB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 6 continued

NNTKUR mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	2.967	0.255	2.900	0.200	3.050	0.100			3.050	0.100	0.150
HPB	0.800	0.000	0.800	0.000	0.750	0.100	0.700	0.000	0.725	0.058	-0.075
PCA	0.700	0.000	0.750	0.100	0.750	0.300			0.750	0.300	0.000
PCB	1.200	0.122	1.100	0.000	1.050	0.100	1.000	0.000	1.025	0.058	-0.075
TYA	1.367	0.071	1.250	0.100	1.350	0.100			1.350	0.100	0.100
TYB	3.467	0.255	3.000	0.000	2.850	0.300	2.850	0.500	2.850	0.275	-0.150
KDB	1.033	0.071	1.600	0.800	1.150	0.100	1.150	0.100	1.150	0.067	-0.450
HEB	0.550	0.100	0.350	0.300	0.500	0.000	0.550	0.100	0.525	0.058	0.175

ORGC mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	57.0	5.3	47.8	0.1	48.8	1.8			48.8	1.8	1.0
HPB	15.3	0.8	15.8	2.3	14.3	2.3	15.0	0.0	14.6	1.2	-1.1
PCA	18.3	1.5	16.3	2.2	13.8	1.0			13.8	1.0	-2.5
PCB	31.5	1.7	25.5	3.5	27.7	1.7	26.4	6.2	27.0	3.1	1.6
TYA	29.4	4.2	23.3	2.2	24.7	0.5			24.7	0.5	1.4
TYB	60.0	3.6	54.5	0.8	57.8	0.4	57.2	3.0	57.5	1.5	3.0
KDB	21.4	2.3	22.3	0.4	22.5	3.0	21.0	0.0	21.8	1.7	-0.6
HEB	12.5	1.1	10.1	0.7	9.9	0.3	11.2	1.2	10.5	1.1	0.5

PHECA

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	4.27	0.02	4.14	0.01	3.79	0.00			3.79	0.00	-0.34
HPB	4.66	0.01	4.68	0.03	4.33	0.03	4.29	0.01	4.31	0.03	-0.37
PCA	3.61	0.01	3.84	0.00	3.22	0.06			3.22	0.06	-0.62
PCB	4.58	0.02	4.66	0.06	4.49	0.01	4.58	0.21	4.53	0.12	-0.13
TYA	3.30	0.01	3.47	0.05	3.05	0.03			3.05	0.03	-0.42
TYB	3.81	0.01	4.05	0.02	3.69	0.03	3.70	0.00	3.69	0.02	-0.36
KDB	4.69	0.01	4.68	0.01	4.33	0.02	4.37	0.01	4.35	0.03	-0.33
HEB	4.98	0.01	5.13	0.02	4.07	0.02	4.09	0.02	4.08	0.02	-1.05

PHEW

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	4.85	0.01	4.87	0.06	4.34	0.04			4.34	0.04	-0.53
HPB	5.32	0.03	5.61	0.14	4.72	0.17	4.58	0.01	4.65	0.12	-0.96
PCA	4.25	0.11	4.92	0.02	3.66	0.65			3.66	0.65	-1.26
PCB	4.98	0.04	5.23	0.06	4.53	0.08	4.45	0.01	4.49	0.07	-0.74
TYA	3.92	0.01	4.41	0.14	3.64	0.28			3.64	0.28	-0.77
TYB	4.25	0.00	4.92	0.10	4.19	0.01	4.12	0.17	4.15	0.09	-0.77
KDB	5.38	0.06	5.52	0.01	4.71	0.43	4.62	0.17	4.66	0.23	-0.85
HEB	5.56	0.01	6.10	0.07	4.39	0.03	4.42	0.03	4.40	0.03	-1.69

Table 6 continued

SAND mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	506.7	43.0	525.0	10.0	510.0	0.0			510.0	0.0	-15.0
HPB	770.0	21.2	770.0	20.0	760.0	20.0	775.0	10.0	767.5	14.5	-2.5
PCA	520.0	0.0	525.0	10.0	500.0	0.0			500.0	0.0	-25.0
PCB	570.0	0.0	565.0	50.0	560.0	0.0	580.0	0.0	570.0	13.3	5.0
TYA	393.3	14.1	390.0	20.0	455.0	70.0			455.0	70.0	65.0
TYB	490.0	12.2	500.0	0.0	515.0	10.0	535.0	30.0	525.0	20.0	25.0
KDB	840.0	44.2	830.0	40.0	830.0	0.0	850.0	0.0	840.0	13.3	10.0
HEB	660.0	40.0	650.0	40.0	685.0	10.0	660.0	60.0	672.5	33.2	22.5

SIEOX mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.733	0.141	0.800	0.000	0.650	0.100			0.650	0.100	-0.150
HPB	1.300	0.122	1.300	0.000	1.300	0.000	1.250	0.100	1.275	0.058	-0.025
PCA	0.400	0.122	0.350	0.100	0.450	0.100			0.450	0.100	0.100
PCB	2.067	0.071	1.400	0.000	1.400	0.400	1.250	0.100	1.325	0.219	-0.075
TYA	0.300	0.000	0.200	0.000	0.400	0.000			0.400	0.000	0.200
TYB	1.667	0.141	1.350	0.100	1.450	0.100	1.900	0.800	1.675	0.484	0.325
KDB	1.967	0.141	1.800	0.400	2.350	0.300	2.300	0.800	2.325	0.404	0.525
HEB	1.400	0.400	1.100	0.000	1.250	0.100	1.050	0.100	1.150	0.149	0.050

SILT mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	370.0	32.4	365.0	10.0	370.0	0.0			370.0	0.0	5.0
HPB	203.3	14.1	225.0	10.0	225.0	10.0	215.0	10.0	220.0	9.4	-5.0
PCA	440.0	0.0	440.0	0.0	455.0	10.0			455.0	10.0	15.0
PCB	416.7	7.1	420.0	40.0	430.0	0.0	405.0	10.0	417.5	17.3	-2.5
TYA	543.3	14.1	540.0	20.0	490.0	60.0			490.0	60.0	-50.0
TYB	396.7	14.1	400.0	0.0	390.0	0.0	370.0	20.0	380.0	16.3	-20.0
KDB	143.3	49.5	125.0	10.0	130.0	40.0	130.0	0.0	130.0	18.9	5.0
HEB	315.0	30.0	300.0	20.0	290.0	0.0	275.0	30.0	282.5	17.3	-17.5

SSO4AD mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.031	0.001	0.014	0.001	0.025	0.002			0.025	0.002	0.011
HPB	0.058	0.002	0.014	0.001	0.060	0.004	0.061	0.000	0.061	0.002	0.047
PCA	0.012	0.001	0.000	0.001	0.003	0.001			0.003	0.001	0.003
PCB	0.569	0.012	0.349	0.013	0.587	0.009	0.560	0.004	0.573	0.018	0.225
TYA	0.013	0.001	0.002	0.001	0.004	0.000			0.004	0.000	0.002
TYB	0.052	0.002	0.012	0.000	0.047	0.001	0.046	0.002	0.047	0.001	0.035
KDB	0.151	0.005	0.043	0.000	0.109	0.017	0.100	0.000	0.104	0.010	0.061
HEB	0.036	0.002	0.005	0.002	0.019	0.000	0.019	0.001	0.019	0.000	0.013

Table 6 continued

SSO4EW mg/g

	BACKGROUND		CONTROL		TREATMENT 1		TREATMENT 2		TREAT 1 & 2		treat1&2
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	-control
HPA	0.014	0.002	0.003	0.001	0.004	0.000			0.004	0.000	0.001
HPB	0.010	0.001	0.001	0.001	0.002	0.000	0.003	0.000	0.002	0.001	0.002
PCA	0.010	0.002	0.000	0.001	0.001	0.001			0.001	0.001	0.001
PCB	0.022	0.003	0.007	0.000	0.003	0.000	0.004	0.000	0.004	0.001	-0.004
TYA	0.014	0.001	0.002	0.001	0.004	0.000			0.004	0.000	0.002
TYB	0.017	0.001	0.002	0.001	0.004	0.000	0.003	0.000	0.003	0.001	0.002
KDB	0.021	0.001	0.002	0.000	0.000	0.001	0.001	0.000	0.000	0.000	-0.001
HEB	0.010	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7 Chemistry and Total Mass of Individual Runs (Experiment #3)

HARP CONTROL 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.95	0.141	0.321	*0.0108	494.01	0.070	0.158	0.0053
2	5.00	0.141	0.321	0.0108	464.34	0.065	0.149	0.0050
3	5.11	0.084	0.096	*0.0063	473.68	0.040	0.046	0.0030
4	5.14	0.084	0.096	0.0063	471.81	0.040	0.045	0.0030
5	5.09	0.076	0.089	*0.0013	469.61	0.036	0.042	0.0006
6	5.13	0.076	0.089	0.0013	459.42	0.035	0.041	0.0006
7	5.16	0.092	0.075	*0.0013	468.15	0.043	0.035	0.0006
8	5.24	0.092	0.075	*0.0013	474.78	0.044	0.036	0.0006
9	5.23	0.079	0.079	*0.0013	454.95	0.036	0.036	0.0006
10	5.26	0.079	0.079	*0.0013	469.30	0.037	0.037	0.0006
11	5.23	0.051	0.082	*0.0013	461.21	0.024	0.038	0.0006
12	5.20	0.051	0.082	*0.0013	476.18	0.024	0.039	0.0006
13	5.25	0.063	0.058	*0.0013	475.85	0.030	0.028	0.0006
14	5.09	0.063	0.058	*0.0013	461.95	0.029	0.027	0.0006
15	5.26	*0.057	0.103	*0.0013	464.20	0.026	0.048	0.0006
16	*5.21	*0.057	0.103	*0.0013	468.41	0.027	0.048	0.0006
Total leached					7507.9	0.605	0.853	0.0236

HARP CONTROL 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.97	0.147	0.321	*0.0110	494.32	0.073	0.159	0.0054
2	5.04	0.147	0.321	0.0110	462.81	0.068	0.148	0.0051
3	5.13	0.113	0.110	*0.0066	483.29	0.055	0.053	0.0032
4	5.16	0.113	0.110	0.0066	468.57	0.053	0.052	0.0031
5	5.11	0.109	0.093	*0.0030	461.08	0.050	0.043	0.0014
6	5.16	0.109	0.093	0.0030	470.51	0.051	0.044	0.0014
7	5.19	0.099	0.079	*0.0030	463.02	0.046	0.037	0.0014
8	5.27	0.099	0.079	*0.0030	465.01	0.046	0.037	0.0014
9	5.26	0.125	0.103	*0.0030	454.95	0.057	0.047	0.0014
10	5.30	0.125	0.103	*0.0030	469.30	0.059	0.049	0.0014
11	5.27	0.055	0.075	*0.0030	461.21	0.025	0.035	0.0014
12	5.24	0.055	0.075	*0.0030	476.18	0.026	0.036	0.0014
13	5.28	0.065	0.065	*0.0030	475.85	0.031	0.031	0.0014
14	5.28	0.065	0.065	*0.0030	461.95	0.030	0.030	0.0014
15	5.31	*0.06	0.103	*0.0030	464.20	0.028	0.048	0.0014
16	*5.28	*0.06	0.103	*0.0030	468.41	0.028	0.048	0.0014
Total leached					7500.7	0.726	0.895	0.0336

* missing data - calculated value

Table 7 continued

HARP TREATMENT 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	3.91	6.070	0.724	*0.1160	494.81	3.003	0.358	0.0574
2	3.51	6.070	0.724	0.1160	464.99	2.822	0.337	0.0539
3	3.44	4.750	0.638	*0.0940	471.63	2.240	0.301	0.0444
4	3.38	4.750	0.638	0.0942	468.88	2.227	0.299	0.0442
5	3.32	3.340	0.821	*0.1230	456.18	1.524	0.375	0.0561
6	3.31	3.340	0.821	0.1230	454.73	1.519	0.373	0.0559
7	3.30	3.950	0.832	*0.0911	456.65	1.804	0.380	0.0416
8	3.32	3.950	0.832	0.0911	456.63	1.804	0.380	0.0416
9	3.30	3.920	1.048	*0.0828	460.75	1.806	0.483	0.0382
10	3.33	3.920	1.048	0.0828	463.09	1.815	0.485	0.0383
11	3.27	3.320	1.087	*0.0507	460.22	1.528	0.500	0.0233
12	3.35	3.320	1.087	0.0507	465.81	1.546	0.506	0.0236
13	3.27	3.430	0.785	*0.0256	467.86	1.605	0.367	0.0120
14	3.23	3.430	0.785	0.0256	460.78	1.580	0.362	0.0118
15	3.23	3.250	0.944	*0.0131	467.06	1.518	0.441	0.0061
16	3.24	3.250	0.944	0.0131	462.47	1.503	0.436	0.0061
Total leached					7432.5	29.845	6.384	0.5546

HARP TREATMENT 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	3.91	6.300	0.721	*0.1140	494.27	3.114	0.356	0.0563
2	3.53	6.300	0.721	0.1140	453.15	2.855	0.327	0.0517
3	3.45	4.750	0.634	*0.0858	465.93	2.213	0.296	0.0400
4	3.39	4.750	0.634	0.0858	459.54	2.183	0.292	0.0394
5	3.32	4.280	0.811	*0.1230	469.24	2.008	0.380	0.0577
6	3.32	4.280	0.811	0.1230	455.97	1.952	0.370	0.0561
7	3.28	3.910	0.814	*0.0833	449.16	1.756	0.366	0.0374
8	3.33	3.910	0.814	0.0833	468.92	1.833	0.382	0.0391
9	3.29	3.930	1.048	*0.0732	465.93	1.831	0.488	0.0341
10	3.32	3.930	1.048	0.0732	468.82	1.842	0.491	0.0343
11	3.27	3.100	1.091	*0.0482	463.06	1.435	0.505	0.0223
12	3.34	3.100	1.091	0.0482	473.50	1.468	0.517	0.0228
13	3.26	3.450	0.793	*0.0262	470.98	1.625	0.373	0.0123
14	3.23	3.450	0.793	0.0262	464.21	1.602	0.368	0.0122
15	3.21	3.160	0.969	*0.0131	474.81	1.500	0.460	0.0062
16	3.23	3.160	0.969	*0.0131	473.61	1.497	0.459	0.0062
Total leached					7471.1	30.715	6.428	0.5282

* missing data - calculated value

Table 7 continued

HAWKEYE CONTROL 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	5.37	0.753	1.035	*0.0058	494.34	0.372	0.512	0.0029
2	5.47	0.753	1.035	0.0058	476.36	0.359	0.493	0.0028
3	5.49	0.086	0.230	*0.0024	468.84	0.040	0.108	0.0011
4	5.52	0.086	0.230	0.0024	469.60	0.040	0.108	0.0011
5	5.49	0.093	0.162	*0.0020	477.40	0.044	0.077	0.0010
6	5.50	0.093	0.162	0.0020	468.43	0.044	0.076	0.0009
7	5.49	0.060	0.134	*0.0020	458.18	0.027	0.061	0.0009
8	5.54	0.060	0.134	*0.0020	461.55	0.028	0.062	0.0009
9	5.47	0.063	0.141	*0.0020	465.65	0.029	0.066	0.0009
10	5.57	0.063	0.141	*0.0020	461.92	0.029	0.065	0.0009
11	5.51	0.040	0.134	*0.0020	471.65	0.019	0.063	0.0009
12	5.48	0.040	0.134	*0.0020	476.68	0.019	0.064	0.0010
13	5.44	0.058	0.108	*0.0020	465.04	0.027	0.050	0.0009
14	5.47	0.058	0.108	*0.0020	476.43	0.028	0.052	0.0010
15	5.46	0.050	0.098	*0.0020	468.27	0.023	0.046	0.0009
16	5.41	0.050	0.098	*0.0020	474.50	0.024	0.046	0.0009
Total leached					7534.8	1.153	1.948	0.0191

HAWKEYE CONTROL 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	5.38	0.842	1.071	*0.0067	494.28	0.416	0.529	0.0033
2	5.51	0.842	1.071	0.0067	467.51	0.394	0.501	0.0031
3	5.55	0.142	0.255	*0.0020	463.13	0.066	0.118	0.0009
4	5.56	0.142	0.255	0.0020	466.91	0.066	0.119	0.0009
5	5.54	0.111	0.180	*0.0029	466.99	0.052	0.084	0.0014
6	5.55	0.111	0.180	0.0029	469.21	0.052	0.084	0.0014
7	5.53	0.063	0.137	*0.0029	456.91	0.029	0.063	0.0013
8	5.58	0.063	0.137	*0.0029	445.68	0.028	0.061	0.0013
9	5.51	0.052	0.141	*0.0029	463.42	0.024	0.065	0.0013
10	5.60	0.052	0.141	*0.0029	461.79	0.024	0.065	0.0013
11	5.54	0.046	0.134	*0.0029	460.71	0.021	0.062	0.0013
12	5.49	0.046	0.134	*0.0029	468.97	0.022	0.063	0.0014
13	5.50	0.072	0.116	*0.0029	462.92	0.033	0.054	0.0013
14	5.49	0.072	0.116	*0.0029	472.11	0.034	0.055	0.0014
15	5.53	0.070	0.116	*0.0029	469.11	0.033	0.054	0.0014
16	5.48	0.070	0.116	*0.0029	475.95	0.033	0.055	0.0014
Total leached					7465.6	1.327	2.031	0.0245

* missing data - calculated value

Table 7 continued

HAWKEYE TREATMENT 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.04	3.690	1.329	*0.0626	494.54	1.825	0.657	0.0310
2	3.60	3.690	1.329	0.0626	457.29	1.687	0.608	0.0286
3	3.46	4.670	1.082	*0.0336	457.64	2.137	0.495	0.0154
4	3.36	4.670	1.082	0.0336	460.50	2.151	0.498	0.0155
5	3.32	3.460	1.190	*0.0319	463.03	1.602	0.551	0.0148
6	3.29	3.460	1.190	0.0319	460.95	1.595	0.548	0.0147
7	3.25	3.080	1.100	*0.0221	469.44	1.446	0.516	0.0104
8	3.27	3.080	1.100	0.0221	459.15	1.414	0.505	0.0101
9	3.22	3.170	1.200	*0.0208	462.06	1.465	0.555	0.0096
10	3.28	3.170	1.200	0.0208	459.26	1.456	0.551	0.0096
11	3.24	2.780	1.229	*0.0163	466.04	1.296	0.573	0.0076
12	3.22	2.780	1.229	0.0163	464.18	1.290	0.570	0.0076
13	3.22	2.660	0.863	*0.0098	470.00	1.250	0.406	0.0046
14	3.18	2.660	0.863	0.0098	473.46	1.259	0.409	0.0046
15	3.16	2.390	0.924	*0.0021	476.08	1.138	0.440	0.0010
16	3.19	2.390	0.924	0.0021	472.42	1.129	0.437	0.0010
Total leached					7466.0	24.140	8.320	0.1860

HAWKEYE TREATMENT 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.04	3.690	1.311	*0.0626	494.46	1.825	0.648	0.0310
2	3.57	3.690	1.311	0.0626	471.02	1.738	0.618	0.0295
3	3.46	4.790	1.111	*0.0344	451.00	2.160	0.501	0.0155
4	3.35	4.790	1.111	0.0344	476.05	2.280	0.529	0.0164
5	3.31	4.160	1.193	*0.0292	476.39	1.982	0.568	0.0139
6	3.29	4.160	1.193	0.0292	463.32	1.927	0.553	0.0135
7	3.25	3.400	1.111	*0.0227	452.69	1.539	0.503	0.0103
8	3.27	3.400	1.111	0.0227	463.60	1.576	0.515	0.0105
9	3.21	3.230	1.182	*0.0196	460.95	1.489	0.545	0.0090
10	3.27	3.230	1.182	0.0196	477.55	1.542	0.565	0.0094
11	3.24	2.620	1.261	*0.0156	444.73	1.165	0.561	0.0069
12	3.21	2.620	1.261	0.0156	467.13	1.224	0.589	0.0073
13	3.21	2.800	0.860	*0.0101	469.54	1.315	0.404	0.0047
14	3.18	2.800	0.860	0.0101	467.04	1.308	0.402	0.0047
15	3.16	2.360	0.935	*0.0025	475.06	1.121	0.444	0.0012
16	3.19	2.360	0.935	0.0025	477.35	1.127	0.446	0.0012
Total leached					7487.9	25.318	8.390	0.1850

* missing data - calculated value

Table 7 continued

KIRKWOOD CONTROL 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	5.03	0.220	0.384	*0.0061	494.19	0.109	0.190	0.0030
2	5.06	0.220	0.384	0.0061	468.39	0.103	0.180	0.0029
3	5.12	0.129	0.110	*0.0035	462.25	0.060	0.051	0.0016
4	5.14	0.129	0.110	0.0035	469.73	0.061	0.052	0.0016
5	5.10	0.098	0.082	*0.0026	461.43	0.045	0.038	0.0012
6	5.12	0.098	0.082	0.0026	467.09	0.046	0.038	0.0012
7	5.15	0.077	0.065	*0.0026	453.24	0.035	0.029	0.0012
8	5.24	0.077	0.065	*0.0026	465.17	0.036	0.030	0.0012
9	5.21	0.094	0.072	*0.0026	461.43	0.043	0.033	0.0012
10	5.25	0.094	0.072	*0.0026	455.88	0.043	0.033	0.0012
11	5.21	0.061	0.072	*0.0026	464.51	0.028	0.033	0.0012
12	5.18	0.061	0.072	*0.0026	462.30	0.028	0.033	0.0012
13	5.20	0.102	0.072	*0.0026	472.95	0.048	0.034	0.0012
14	5.25	0.102	0.072	*0.0026	468.17	0.048	0.034	0.0012
15	5.24	0.170	0.054	*0.0026	468.29	0.080	0.025	0.0012
16	4.81	0.170	0.054	*0.0026	471.38	0.080	0.026	0.0012
Total leached					7466.4	0.892	0.859	0.0236

KIRKWOOD CONTROL 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	5.02	0.210	0.391	*0.0059	494.58	0.104	0.193	0.0029
2	5.10	0.210	0.391	0.0059	461.27	0.097	0.180	0.0027
3	5.16	0.143	0.110	*0.0031	459.43	0.066	0.051	0.0014
4	5.17	0.143	0.110	0.0031	455.52	0.065	0.050	0.0014
5	5.13	0.111	0.075	*0.0030	469.29	0.052	0.035	0.0014
6	5.16	0.111	0.075	0.0030	458.62	0.051	0.035	0.0014
7	5.18	0.083	0.068	*0.0030	452.22	0.038	0.031	0.0014
8	5.26	0.083	0.068	*0.0030	470.11	0.039	0.032	0.0014
9	5.22	0.080	0.065	*0.0030	458.28	0.037	0.030	0.0014
10	5.27	0.080	0.065	*0.0030	466.90	0.037	0.030	0.0014
11	5.25	0.063	0.065	*0.0030	460.03	0.029	0.030	0.0014
12	5.21	0.063	0.065	*0.0030	473.24	0.030	0.031	0.0014
13	5.24	0.099	0.054	*0.0030	466.69	0.046	0.025	0.0014
14	5.28	0.099	0.054	*0.0030	469.59	0.046	0.026	0.0014
15	5.27	0.200	0.061	*0.0030	466.94	0.093	0.029	0.0014
16	4.85	0.200	0.061	*0.0030	465.30	0.093	0.029	0.0014
Total leached					7448.0	0.923	0.836	0.0252

* missing data - calculated value

Table 7 continued

KIRKWOOD TREATMENT 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.02	7.150	0.782	*0.0623	494.10	3.533	0.386	0.0308
2	3.73	7.150	0.782	0.0623	454.96	3.253	0.356	0.0283
3	3.55	5.920	0.678	*0.0165	468.45	2.773	0.317	0.0077
4	3.47	5.920	0.678	0.0165	455.61	2.697	0.309	0.0075
5	3.40	4.590	0.872	*0.0078	465.39	2.136	0.406	0.0036
6	3.37	4.590	0.872	0.0078	465.51	2.137	0.406	0.0036
7	3.34	4.580	0.933	*0.0062	456.12	2.089	0.425	0.0028
8	3.38	4.580	0.933	0.0062	459.46	2.104	0.429	0.0028
9	3.34	4.560	1.177	*0.0069	461.44	2.104	0.543	0.0032
10	3.38	4.560	1.177	0.0069	462.08	2.107	0.544	0.0032
11	3.33	3.480	1.249	*0.0058	456.14	1.587	0.570	0.0026
12	3.40	3.480	1.249	0.0058	464.46	1.616	0.580	0.0027
13	3.34	4.000	0.961	*0.0047	472.45	1.890	0.454	0.0022
14	3.28	4.000	0.961	0.0047	459.44	1.838	0.442	0.0022
15	3.26	3.640	1.116	*0.0047	473.61	1.724	0.529	0.0022
16	3.29	3.640	1.116	*0.0047	476.99	1.736	0.532	0.0022
Total leached					7446.2	35.325	7.227	0.1079

KIRKWOOD TREATMENT 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.02	6.500	0.767	*0.0596	494.07	3.211	0.379	0.0294
2	3.70	6.500	0.767	0.0596	477.10	3.101	0.366	0.0284
3	3.54	5.840	0.674	*0.0119	470.81	2.750	0.317	0.0056
4	3.44	5.840	0.674	0.0119	464.76	2.714	0.313	0.0055
5	3.39	4.590	0.893	*0.0088	469.73	2.156	0.420	0.0041
6	3.37	4.590	0.893	0.0088	462.92	2.125	0.413	0.0041
7	3.34	4.510	0.947	*0.0067	442.73	1.997	0.419	0.0030
8	3.38	4.510	0.947	0.0067	460.18	2.075	0.436	0.0031
9	3.34	4.460	1.181	*0.0056	457.16	2.039	0.540	0.0026
10	3.38	4.460	1.181	0.0056	459.35	2.049	0.542	0.0026
11	3.33	3.140	1.231	*0.0051	467.54	1.468	0.576	0.0024
12	3.39	3.140	1.231	0.0051	469.29	1.474	0.578	0.0024
13	3.32	3.880	0.954	*0.0040	474.75	1.842	0.453	0.0019
14	3.27	3.880	0.954	0.0040	462.17	1.793	0.441	0.0018
15	3.26	3.690	1.134	*0.0040	474.40	1.751	0.538	0.0019
16	3.29	3.690	1.134	*0.0040	470.33	1.736	0.533	0.0019
Total leached					7477.3	34.280	7.265	0.1007

* missing data - calculated value

Table 7 continued

PLASTIC CONTROL 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.72	0.431	0.498	*0.0200	494.63	0.213	0.247	0.0099
2	4.83	0.431	0.498	0.0200	470.96	0.203	0.235	0.0094
3	4.89	0.239	0.191	*0.0093	459.28	0.110	0.088	0.0043
4	4.92	0.239	0.191	0.0093	463.23	0.111	0.088	0.0043
5	4.96	0.145	0.144	*0.0070	463.58	0.067	0.067	0.0032
6	4.98	0.145	0.144	0.0070	469.50	0.068	0.068	0.0033
7	4.99	0.130	0.123	*0.0070	460.62	0.060	0.057	0.0032
8	5.06	0.130	0.123	*0.0070	461.28	0.060	0.057	0.0032
9	5.00	0.131	0.130	*0.0070	461.04	0.060	0.060	0.0032
10	5.11	0.131	0.130	*0.0070	460.98	0.060	0.060	0.0032
11	5.07	0.108	0.151	*0.0070	453.73	0.049	0.069	0.0032
12	4.99	0.108	0.151	*0.0070	477.53	0.052	0.072	0.0033
13	5.06	0.081	0.116	*0.0070	463.08	0.038	0.054	0.0032
14	5.05	0.081	0.116	*0.0070	472.76	0.038	0.055	0.0033
15	5.11	0.100	0.105	*0.0070	472.21	0.047	0.050	0.0033
16	5.12	0.100	0.105	*0.0070	466.61	0.047	0.049	0.0033
Total leached					7471.0	1.283	1.373	0.0670

PLASTIC CONTROL 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.73	0.443	0.502	*0.0207	494.69	0.219	0.248	0.0102
2	4.86	0.443	0.502	0.0207	469.50	0.208	0.236	0.0097
3	4.92	0.231	0.198	*0.0106	448.62	0.104	0.089	0.0048
4	4.95	0.231	0.198	0.0106	464.77	0.107	0.092	0.0049
5	4.98	0.160	0.151	*0.0070	465.14	0.074	0.070	0.0033
6	5.00	0.160	0.151	0.0070	466.61	0.075	0.071	0.0033
7	5.01	0.129	0.123	*0.0070	469.68	0.061	0.058	0.0033
8	5.08	0.129	0.123	*0.0070	456.08	0.059	0.056	0.0032
9	5.03	0.108	0.130	*0.0070	461.69	0.050	0.060	0.0032
10	5.13	0.108	0.130	*0.0070	457.36	0.049	0.059	0.0032
11	5.10	0.079	0.137	*0.0070	461.53	0.036	0.063	0.0032
12	5.04	0.079	0.137	*0.0070	470.67	0.037	0.065	0.0033
13	5.09	0.080	0.108	*0.0070	460.74	0.037	0.050	0.0032
14	5.10	0.080	0.108	*0.0070	456.86	0.037	0.050	0.0032
15	5.13	0.100	0.101	*0.0070	464.33	0.046	0.047	0.0033
16	5.17	0.100	0.101	*0.0070	465.70	0.047	0.047	0.0033
Total leached					7434.0	1.246	1.361	0.0685

* missing data - calculated value

Table 7 continued

PLASTIC TREATMENT 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	3.98	7.310	0.874	*0.0879	494.73	3.616	0.433	0.0435
2	3.67	7.310	0.874	0.0879	476.17	3.481	0.416	0.0419
3	3.57	6.070	0.734	*0.0317	454.16	2.757	0.334	0.0144
4	3.49	6.070	0.734	0.0317	448.86	2.725	0.330	0.0142
5	3.41	5.100	0.842	*0.0259	468.17	2.388	0.394	0.0121
6	3.43	5.100	0.842	0.0259	461.47	2.353	0.389	0.0120
7	3.40	4.990	0.924	*0.0227	444.35	2.217	0.411	0.0101
8	3.43	4.990	0.924	0.0227	451.73	2.254	0.418	0.0103
9	3.39	5.280	1.129	*0.0229	454.68	2.401	0.513	0.0104
10	3.47	5.280	1.129	0.0229	461.77	2.438	0.521	0.0106
11	3.40	4.330	1.286	*0.0205	457.75	1.982	0.589	0.0094
12	3.39	4.330	1.286	0.0205	475.75	2.060	0.612	0.0098
13	3.41	4.650	1.028	*0.0149	468.45	2.178	0.482	0.0070
14	3.32	4.650	1.028	0.0149	463.79	2.157	0.477	0.0069
15	3.31	4.170	1.182	*0.0076	471.01	1.964	0.557	0.0036
16	3.35	4.170	1.182	0.0076	468.51	1.954	0.554	0.0036
Total leached					7421.4	38.925	7.428	0.2195

PLASTIC TREATMENT 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	3.98	7.310	0.867	*0.0889	494.77	3.617	0.429	0.0440
2	3.67	7.310	0.867	0.0889	468.81	3.427	0.406	0.0417
3	3.54	5.910	0.706	*0.0307	453.46	2.680	0.320	0.0139
4	3.45	5.910	0.706	0.0307	466.46	2.757	0.329	0.0143
5	3.40	5.410	0.842	*0.0257	467.91	2.531	0.394	0.0120
6	3.42	5.410	0.842	0.0257	465.03	2.516	0.392	0.0120
7	3.38	5.000	0.917	*0.0222	458.96	2.295	0.421	0.0102
8	3.41	5.000	0.917	0.0222	466.04	2.330	0.427	0.0103
9	3.37	5.050	1.111	*0.0220	464.85	2.347	0.516	0.0102
10	3.45	5.050	1.111	0.0220	475.96	2.404	0.529	0.0105
11	3.39	4.510	1.311	*0.0213	462.12	2.084	0.606	0.0098
12	3.38	4.510	1.311	0.0213	468.82	2.114	0.615	0.0100
13	3.40	4.650	1.028	*0.0162	458.49	2.132	0.471	0.0074
14	3.31	4.650	1.028	0.0162	473.93	2.204	0.487	0.0077
15	3.30	4.270	1.186	*0.0081	467.56	1.996	0.554	0.0038
16	3.34	4.270	1.186	0.0081	474.67	2.027	0.563	0.0038
Total leached					7487.8	39.461	7.461	0.2217

* missing data - calculated value

Table 7 continued

TURKEY CONTROL 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.28	1.960	0.169	*0.0222	494.85	0.970	0.084	0.0110
2	4.48	1.960	0.169	0.0222	462.39	0.906	0.078	0.0103
3	4.53	0.410	0.041	*0.0049	469.15	0.192	0.019	0.0023
4	4.56	0.410	0.041	0.0049	433.92	0.178	0.018	0.0021
5	4.57	0.316	0.033	*0.0030	457.29	0.145	0.015	0.0014
6	4.61	0.316	0.033	0.0030	461.22	0.146	0.015	0.0014
7	4.63	0.222	0.023	*0.0030	451.22	0.100	0.010	0.0014
8	4.71	0.222	0.023	*0.0030	474.50	0.105	0.011	0.0014
9	4.67	0.128	0.033	*0.0030	448.96	0.057	0.015	0.0013
10	4.75	0.128	0.033	*0.0030	453.61	0.058	0.015	0.0014
11	4.67	0.093	0.030	*0.0030	456.03	0.042	0.014	0.0014
12	4.68	0.093	0.030	*0.0030	472.29	0.044	0.014	0.0014
13	4.70	0.093	0.023	*0.0030	462.66	0.043	0.010	0.0014
14	4.74	0.093	0.023	*0.0030	471.09	0.044	0.011	0.0014
15	4.74	0.080	0.015	*0.0030	470.09	0.038	0.007	0.0014
16	4.72	0.080	0.015	*0.0030	467.72	0.037	0.007	0.0014
Total leached					7407.0	3.106	0.344	0.0423

TURKEY CONTROL 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	4.27	1.820	0.169	*0.0211	494.64	0.900	0.084	0.0110
2	4.49	1.820	0.169	0.0211	461.14	0.839	0.078	0.0102
3	4.53	0.436	0.037	*0.0052	455.39	0.199	0.017	0.0022
4	4.56	0.436	0.037	0.0052	464.35	0.202	0.017	0.0023
5	4.57	0.325	0.033	*0.0032	470.31	0.153	0.016	0.0014
6	4.62	0.325	0.033	0.0032	458.06	0.149	0.015	0.0014
7	4.64	0.240	0.026	*0.0032	447.63	0.107	0.012	0.0013
8	4.70	0.240	0.026	*0.0032	454.83	0.109	0.012	0.0014
9	4.67	0.165	0.030	*0.0032	458.81	0.076	0.014	0.0014
10	4.74	0.165	0.030	*0.0032	462.15	0.076	0.014	0.0014
11	4.72	0.100	0.030	*0.0032	458.18	0.046	0.014	0.0014
12	4.68	0.100	0.030	*0.0032	466.17	0.047	0.014	0.0014
13	4.71	0.095	0.019	*0.0032	465.67	0.044	0.009	0.0014
14	4.75	0.095	0.019	*0.0032	467.99	0.044	0.009	0.0014
15	4.74	0.090	0.015	*0.0032	471.74	0.042	0.007	0.0014
16	4.77	0.090	0.015	*0.0032	463.24	0.042	0.007	0.0014
Total leached					7420.3	3.076	0.338	0.0424

* missing data - calculated value

Table 7 continued

TURKEY TREATMENT 1								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	3.67	5.290	0.204	*0.0358	494.61	2.616	0.101	0.0177
2	3.48	5.290	0.204	0.0358	469.51	2.484	0.096	0.0168
3	3.42	4.510	0.093	*0.0073	468.67	2.114	0.044	0.0034
4	3.34	4.510	0.093	0.0073	461.41	2.081	0.043	0.0034
5	3.30	3.650	0.111	*0.0048	447.36	1.633	0.050	0.0021
6	3.27	3.650	0.111	0.0048	448.38	1.637	0.050	0.0022
7	3.24	3.360	0.107	*0.0027	452.70	1.521	0.049	0.0012
8	3.26	3.360	0.107	0.0027	464.74	1.562	0.050	0.0013
9	3.21	3.180	0.136	*0.0023	451.31	1.435	0.061	0.0010
10	3.26	3.180	0.136	0.0023	446.39	1.420	0.061	0.0010
11	3.22	2.550	0.154	*0.0007	453.88	1.157	0.070	0.0003
12	3.20	2.550	0.154	0.0007	467.30	1.192	0.072	0.0003
13	3.20	2.260	0.100	*0.0007	454.94	1.028	0.046	0.0003
14	3.23	2.260	0.100	0.0007	457.88	1.035	0.046	0.0003
15	3.17	2.230	0.111	*0.0007	469.42	1.047	0.052	0.0003
16	3.18	2.230	0.111	*0.0007	458.55	1.023	0.051	0.0003
Total leached					7367.1	24.983	0.940	0.0521

TURKEY TREATMENT 2								
Run #	pH	Aluminum (mg/L)	Silica (mg/L)	Fluoride (mg/L)	Volume (mL)	Total Al (mg)	Total Si (mg)	Total F (mg)
1	3.67	5.680	0.208	*0.0383	494.58	2.809	0.103	0.0189
2	3.49	5.680	0.208	0.0383	458.70	2.605	0.095	0.0176
3	3.41	4.980	0.097	*0.0083	457.68	2.279	0.044	0.0038
4	3.34	4.980	0.097	0.0083	456.23	2.272	0.044	0.0038
5	3.29	4.270	0.111	*0.0063	467.73	1.997	0.052	0.0029
6	3.26	4.270	0.111	0.0063	467.72	1.997	0.052	0.0029
7	3.24	3.320	0.111	*0.0029	451.26	1.498	0.050	0.0013
8	3.26	3.320	0.111	0.0029	462.87	1.537	0.051	0.0013
9	3.20	3.090	0.136	*0.0029	456.76	1.411	0.062	0.0013
10	3.25	3.090	0.136	0.0029	463.21	1.431	0.063	0.0013
11	3.21	2.150	0.154	*0.0029	463.35	0.996	0.071	0.0013
12	3.17	2.150	0.154	*0.0029	473.80	1.019	0.073	0.0014
13	3.18	2.400	0.115	*0.0029	461.27	1.107	0.053	0.0013
14	3.17	2.400	0.115	*0.0029	460.36	1.105	0.053	0.0013
15	3.15	2.280	0.115	*0.0029	455.60	1.039	0.052	0.0013
16	3.17	2.280	0.115	*0.0029	461.98	1.053	0.053	0.0013
Total leached					7413.1	26.157	0.972	0.0634

* missing data - calculated value

Table 8 Chemistry of combined (16 day) water samples (Experiment #3)

SITE		Organic Al	Inorganic Al	Total Al*	F*	Ammonium	Nitrate	Ca	Mg	Na	K	SO4	Si*	DOC	Fe	Mn	pH*
HARP	CONTROL 1	0.000	0.061	0.083	0.0071	0.020	0.088		0	0	0.045	0.55	0.10	0.3	0.004	0.008	5.18
	CONTROL 2	0.012	0.066	0.079	0.0078	0.010	0.013		0	0	0.031	0.55	0.12	0.4	0.004	0.009	5.17
	TREATMENT 1	0.099	3.145	3.840	0.0713	0.022	0	0.95	0	0	0.064	0	0.88	1.8	0.086	0.072	3.39
	TREATMENT 2	0.106	2.055	3.800	0.0716	0.023	0	0.95	0	0	0.061	0	0.88	1.9	0.088	0.074	3.38
HAWKEYE	CONTROL 1	0.038	0.058	0.091	0.0027	0.012	0		0.14	0.03	0.149	0	0.18	0.7	0.033	0.002	5.48
	CONTROL 2	0.020	0.049	0.093	0.0027	0.008	0		0.15	0.03	0.154	0	0.20	0.9	0.036	0.003	5.53
	TREATMENT 1	0.097	2.115	3.240	0.0283	0.026	0	1.05	0.13	0.03	0.148	0.35	1.18	1.6	0.285	0.008	3.33
	TREATMENT 2	0.089	2.020	3.200	0.0293	0.020	0	1.05	0.13	0.03	0.157	0	1.20	1.5	0.290	0.008	3.34
KIRKWOOD	CONTROL 1	0.000	0.066	0.074	0.0036	0.016	0		0	0	0.039	0.50	0.12	0.4	0.004	0.016	5.16
	CONTROL 2	0.061	0.066	0.075	0.0040	0.024	0		0	0	0.038	0.55	0.12	0.5	0.004	0.015	5.20
	TREATMENT 1	0.063	3.655	4.590	0.0145	0.036	0	0.30	0	0.03	0.060	0	1.00	1.2	0.091	0.101	3.45
	TREATMENT 2	0.060	2.795	4.710	0.0146	0.028	0	0.30	0	0.03	0.053	0	1.00	1.2	0.100	0.103	3.43
PLASTIC	CONTROL 1	0.100	0.108	0.131	0.0086	0.021	0		0	0	0.040	0.55	0.18	0.5	0.005	0.003	5.06
	CONTROL 2	0.000	0.112	0.147	0.0092	0.020	0		0	0	0.035	0.55	0.18	0.5	0.007	0.003	5.06
	TREATMENT 1	0.068	3.480	5.180	0.0321	0.022	0	0.20	0	0	0.048	0.45	1.04	1.3	0.150	0.010	3.49
	TREATMENT 2	0.063	3.130	4.780	0.0330	0.025	0	0.20	0	0	0.052	0.45	1.06	1.3	0.141	0.010	3.48
TURKEY	CONTROL 1	0.060	0.273	0.352	0.0052	0.185	0.004		0.05	0	0.088	0.35	0.06	2.4	0.185	0.012	4.77
	CONTROL 2	0.038	0.338	0.373	0.0056	0.183	0.004		0.05	0	0.086	0.25	0.06	2.5	0.196	0.012	4.74
	TREATMENT 1	0.097	1.855	3.480	0.0097	0.161	0.002	0.75	0.05	0.03	0.107	0	0.14	5.4	0.707	0.017	3.32
	TREATMENT 2	0.208	2.120	3.440	0.0095	0.189	0.003	0.50	0.05	0.04	0.103	0	0.16	5.9	0.753	0.018	3.31

* more frequent measurements in another table

all values except pH in mg/L

Table 9 Total mass leached (Experiment #3)

SITE		Organic Al	Inorganic Al	Total Al	F	Ammonium	Nitrate	Ca	Mg	Na	K	SO4	Si	DOC	Fe	Mn
HARP	CONTROL 1	0.000	0.458	0.623	0.053	0.150	0.661		0.000	0.000	0.338	4.129	0.751	2.252	0.030	0.060
	CONTROL 2	0.090	0.495	0.593	0.059	0.075	0.098		0.000	0.000	0.233	4.126	0.900	3.000	0.030	0.068
	TREATMENT 1	0.736	23.377	28.543	0.530	0.164	0.000	7.061	0.000	0.000	0.476	0.000	6.541	13.379	0.639	0.535
	TREATMENT 2	0.792	15.353	28.390	0.535	0.172	0.000	7.097	0.000	0.000	0.456	0.000	6.574	14.195	0.657	0.553
HAWKEYE	CONTROL 1	0.286	0.437	0.686	0.020	0.090	0.000		1.055	0.226	1.123	0.000	1.356	5.275	0.249	0.015
	CONTROL 2	0.149	0.366	0.694	0.020	0.060	0.000		1.120	0.224	1.150	0.000	1.493	6.719	0.269	0.022
	TREATMENT 1	0.724	15.791	24.190	0.211	0.194	0.000	7.839	0.971	0.224	1.105	2.613	8.810	11.946	2.128	0.060
	TREATMENT 2	0.666	15.126	23.962	0.219	0.150	0.000	7.862	0.973	0.225	1.176	0.000	8.986	11.232	2.172	0.060
KIRKWOOD	CONTROL 1	0.000	0.493	0.552	0.027	0.119	0.000		0.000	0.000	0.291	3.733	0.896	2.986	0.030	0.119
	CONTROL 2	0.454	0.492	0.559	0.030	0.179	0.000		0.000	0.000	0.283	4.096	0.894	3.724	0.030	0.112
	TREATMENT 1	0.469	27.215	34.177	0.108	0.268	0.000	2.234	0.000	0.223	0.447	0.000	7.446	8.935	0.678	0.752
	TREATMENT 2	0.449	20.898	35.217	0.109	0.209	0.000	2.243	0.000	0.224	0.396	0.000	7.477	8.972	0.748	0.770
PLASTIC	CONTROL 1	0.747	0.807	0.979	0.064	0.157	0.000		0.000	0.000	0.299	4.109	1.345	3.736	0.037	0.022
	CONTROL 2	0.000	0.833	1.093	0.068	0.149	0.000		0.000	0.000	0.260	4.089	1.338	3.717	0.052	0.022
	TREATMENT 1	0.505	25.825	38.441	0.238	0.163	0.000	1.484	0.000	0.000	0.356	3.339	7.718	9.647	1.113	0.074
	TREATMENT 2	0.472	23.437	35.793	0.247	0.187	0.000	1.498	0.000	0.000	0.389	3.370	7.937	9.734	1.056	0.075
TURKEY	CONTROL 1	0.444	2.022	2.607	0.039	1.370	0.030		0.370	0.000	0.652	2.592	0.444	17.777	1.370	0.089
	CONTROL 2	0.282	2.508	2.768	0.042	1.358	0.030		0.371	0.000	0.638	1.855	0.445	18.550	1.454	0.089
	TREATMENT 1	0.715	13.666	25.637	0.071	1.186	0.015	5.525	0.368	0.221	0.788	0.000	1.031	39.782	5.208	0.125
	TREATMENT 2	1.542	15.716	25.501	0.070	1.401	0.022	3.707	0.371	0.297	0.764	0.000	1.186	43.737	5.582	0.133

all values in milligrams

Table 10 Soil Chemistry Experiment #3

ALEDI	CONTROL 1		CONTROL 2		CONTROL 1 & 2		TREATMENT 1		TREATMENT 2		TREATMENT 1 & 2		TREAT 1 & 2
(mg/g)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	- CTRL 1 & 2
HARP	5.700	0.000	5.550	0.350	5.625	0.259	3.750	0.050	3.800	0.100	3.775	0.083	-1.850
PLASTIC	10.600	0.000	10.850	0.150	10.725	0.164	9.850	0.050	9.550	0.050	9.700	0.158	-1.025
TURKEY	8.750	0.550	8.250	0.150	8.500	0.474	5.750	0.250	6.000	0.100	5.875	0.228	-2.625
KIRKWOOD	8.550	0.250	8.650	0.250	8.600	0.255	6.550	0.050	6.450	0.250	6.500	0.187	-2.100
HAWKEYE	5.550	0.050	5.800	0.600	5.675	0.444	4.650	0.050	4.950	0.050	4.800	0.158	-0.875

ALBOX	CONTROL 1		CONTROL 2		CONTROL 1 & 2		TREATMENT 1		TREATMENT 2		TREATMENT 1 & 2		TREAT 1 & 2
(mg/g)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	- CTRL 1 & 2
HARP	8.600	0.100	8.850	0.350	8.725	0.286	4.950	0.050	5.150	0.050	5.050	0.112	-3.675
PLASTIC	17.750	0.350	18.250	0.350	18.000	0.430	14.900	0.400	14.800	0.200	14.850	0.320	-3.150
TURKEY	7.950	0.350	8.450	0.250	8.200	0.394	5.100	0.200	4.900	0.000	5.000	0.173	-3.200
KIRKWOOD	12.450	0.350	12.350	0.050	12.400	0.255	8.750	0.650	8.650	0.450	8.700	0.561	-3.700
HAWKEYE	5.800	0.000	5.750	0.050	5.775	0.043	3.750	0.050	3.750	0.050	3.750	0.050	-2.025

ALEPY	CONTROL 1		CONTROL 2		CONTROL 1 & 2		TREATMENT 1		TREATMENT 2		TREATMENT 1 & 2		TREAT 1 & 2
(mg/g)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	- CTRL 1 & 2
HARP	3.600	0.000	3.500	0.100	3.550	0.087	2.650	0.050	2.650	0.150	2.650	0.112	-0.900
PLASTIC	4.850	0.150	4.500	0.100	4.675	0.217	4.200	0.000	3.950	0.050	4.075	0.130	-0.600
TURKEY	6.300	0.100	6.050	0.050	6.175	0.148	4.650	0.050	4.600	0.100	4.625	0.083	-1.550
KIRKWOOD	4.550	0.150	4.550	0.050	4.550	0.112	4.050	0.250	4.100	0.100	4.075	0.192	-0.475
HAWKEYE	2.700	0.000	2.300	0.200	2.500	0.245	2.500	0.000	2.900	0.100	2.700	0.212	0.200

SIBOX	CONTROL 1		CONTROL 2		CONTROL 1 & 2		TREATMENT 1		TREATMENT 2		TREATMENT 1 & 2		TREAT 1 & 2
(mg/g)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	- CTRL 1 & 2
HARP	1.450	0.050	1.600	0.100	1.525	0.109	1.200	0.000	1.200	0.000	1.200	0.000	-0.325
PLASTIC	4.700	0.200	4.900	0.200	4.800	0.224	3.650	0.050	3.850	0.050	3.750	0.112	-1.050
TURKEY	0.300	0.000	0.350	0.050	0.325	0.043	0.200	0.000	0.200	0.000	0.200	0.000	-0.125
KIRKWOOD	2.600	0.000	2.750	0.050	2.675	0.083	1.900	0.100	1.750	0.150	1.825	0.148	-0.850
HAWKEYE	1.250	0.150	1.250	0.050	1.250	0.112	0.500	0.000	0.450	0.050	0.475	0.043	-0.775

Figure 1

Figure 2

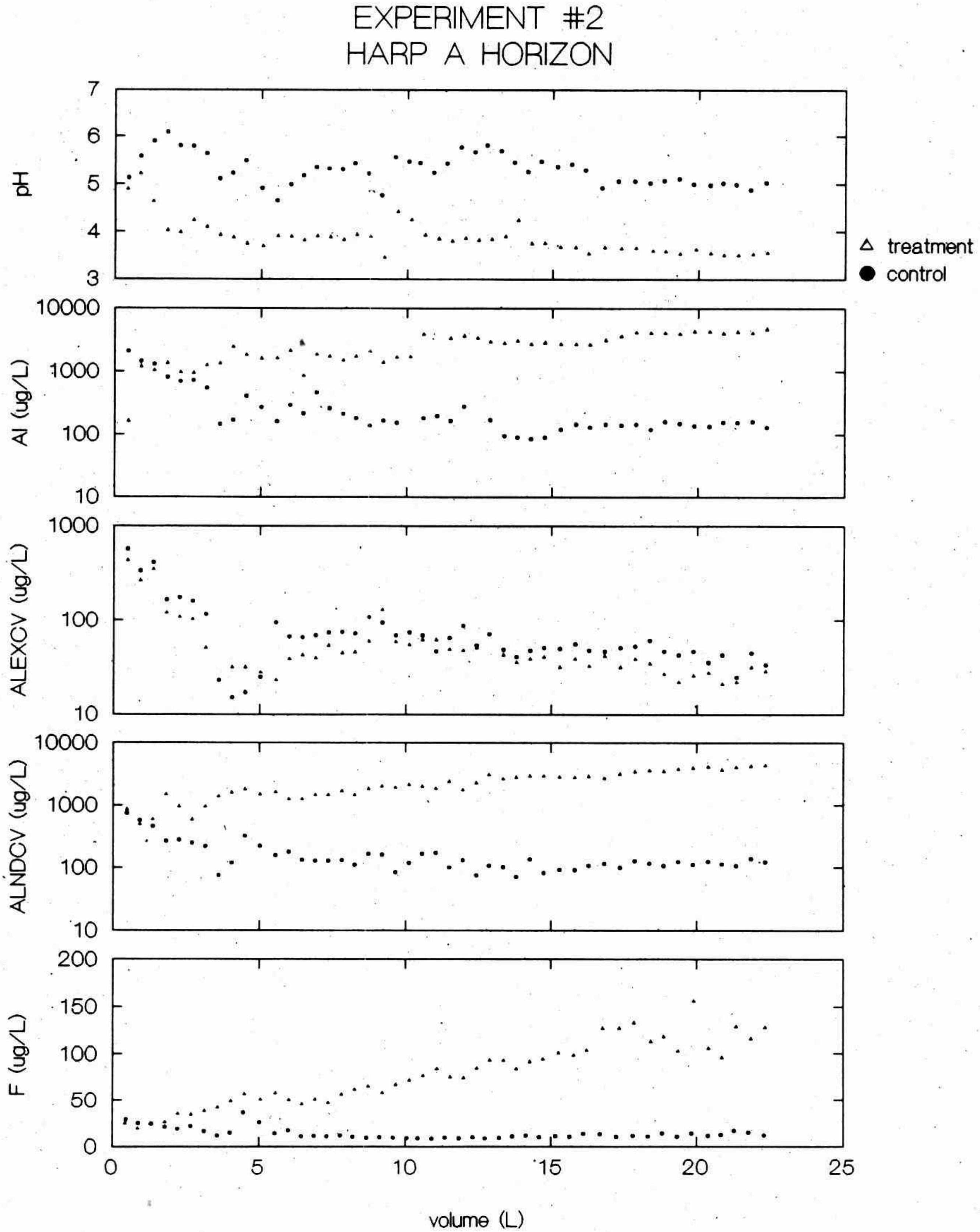

EXPERIMENT #2
HARP A HORIZON
pH
Al (ug/L)
ALEXCV (ug/L)
ALNDCV (ug/L)
F (ug/L)
volume (L)
△ treatment
● control
7
6
5
4
3
10000
1000
100
10
1000
100
10
10000
1000
100
10
200
150
100
50
0
0
5
10
15
20
25

Figure 2

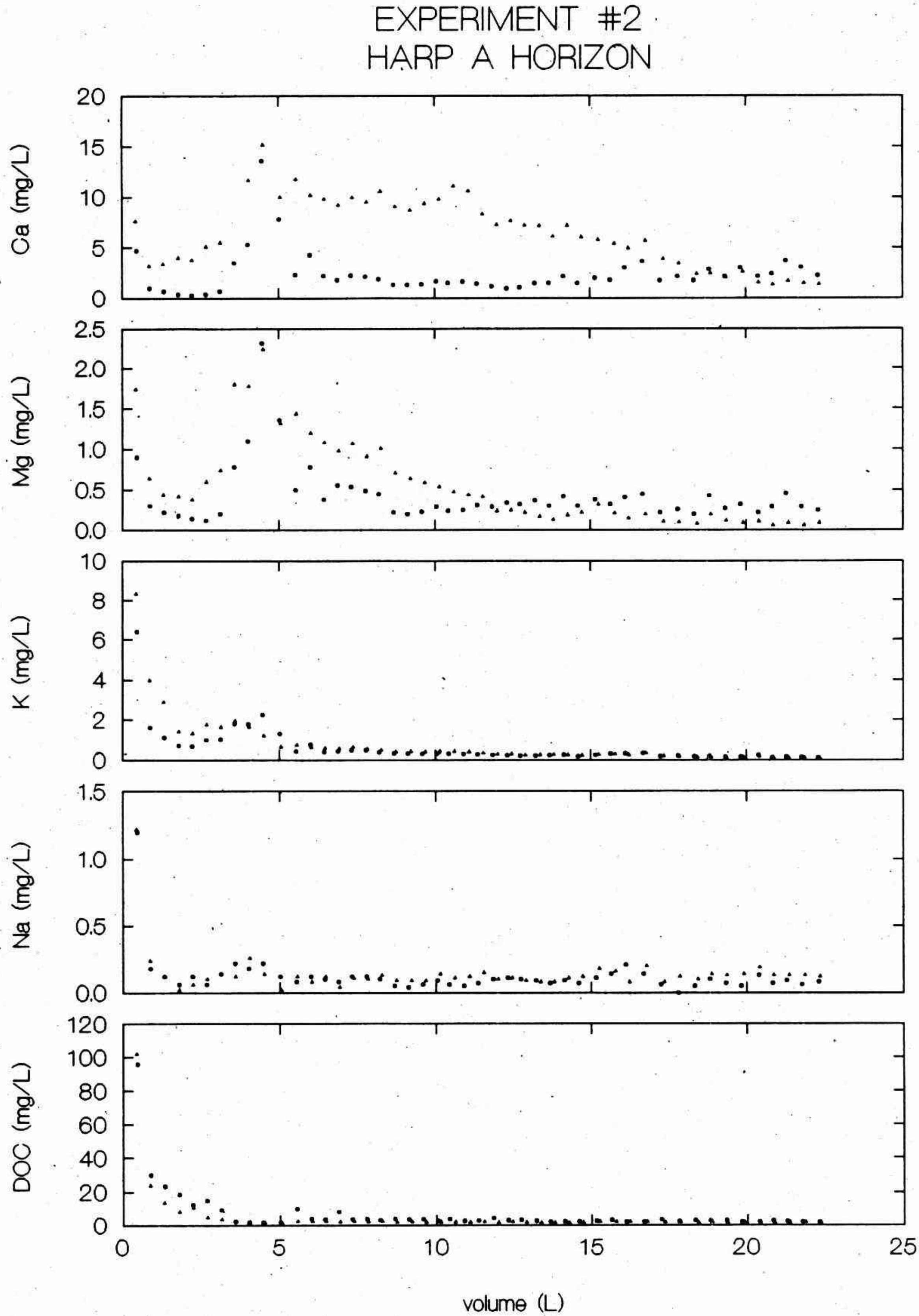

EXPERIMENT #2
HARP A HORIZON
Ca (mg/L)
Mg (mg/L)
K (mg/L)
Na (mg/L)
DOC (mg/L)
volume (L)
0
5
10
15
20
25

Figure 2

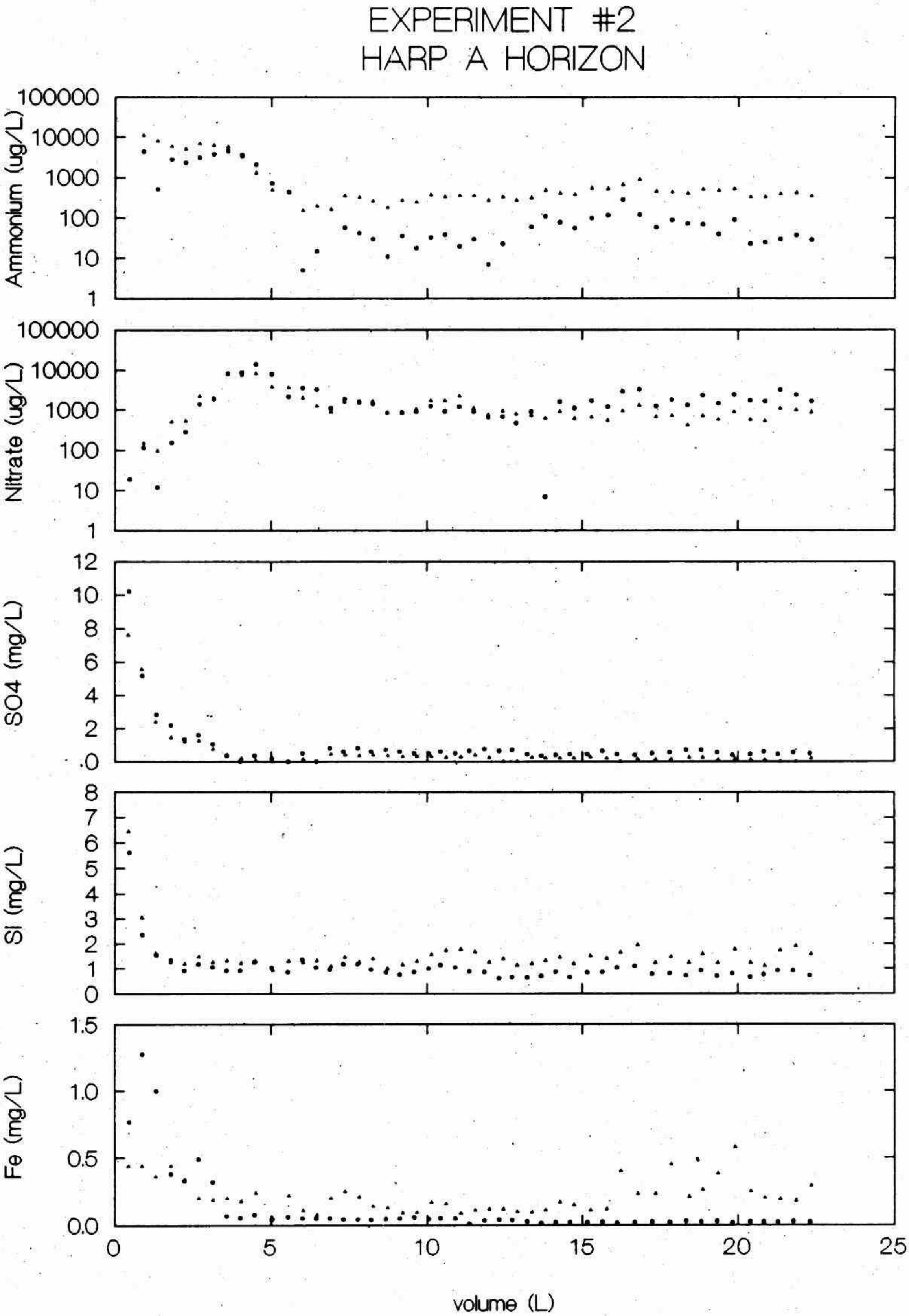

EXPERIMENT #2
HARP A HORIZON
Ammonium (ug/L)
Nitrate (ug/L)
SO4 (mg/L)
SI (mg/L)
Fe (mg/L)
volume (L)

Figure 2

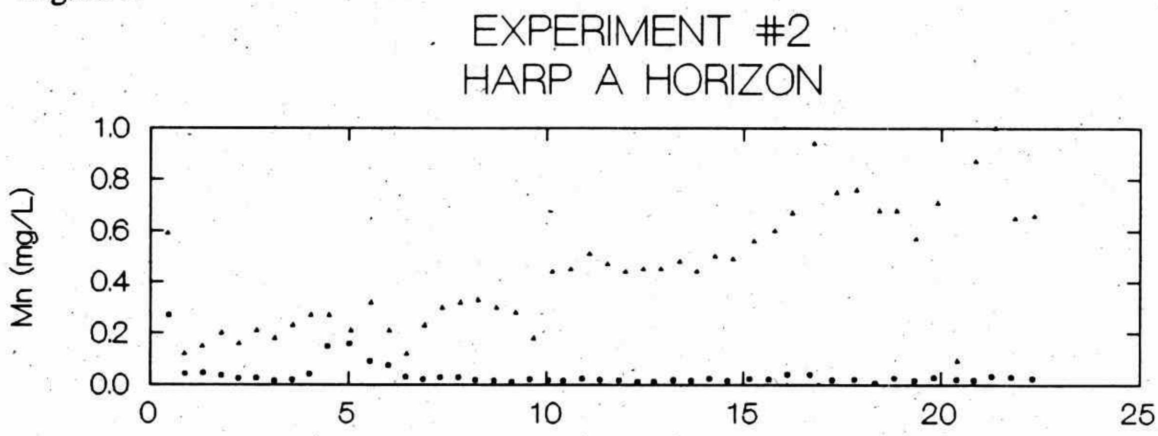

EXPERIMENT #2
HARP A HORIZON
Mn (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25

Figure 2

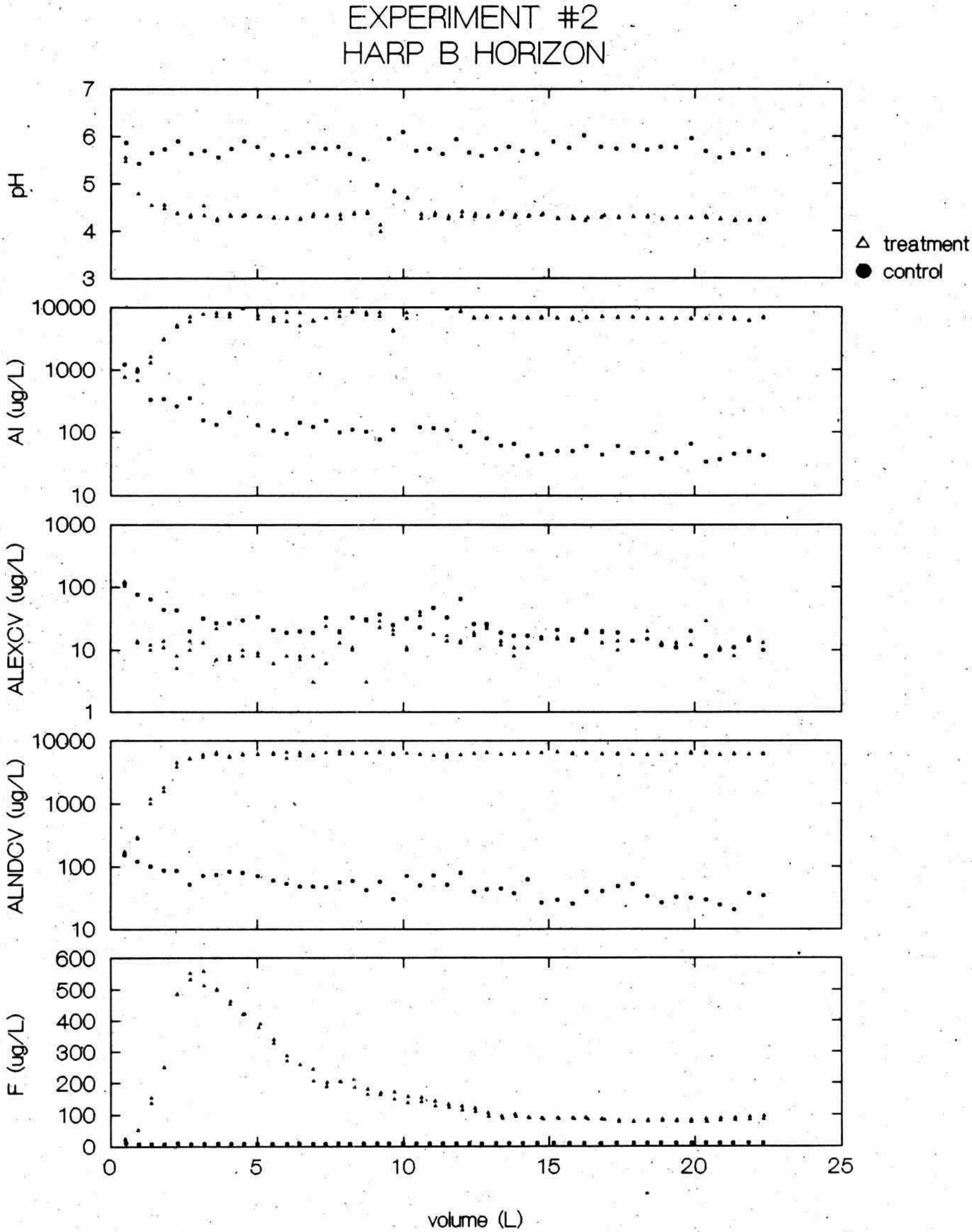

EXPERIMENT #2
HARP B HORIZON
pH
Al (ug/L)
ALEXCV (ug/L)
ALNDCV (ug/L)
F (ug/L)
volume (L)
treatment
control
7
6
5
4
3
10000
1000
100
10
1
600
500
400
300
200
100
0
0
5
10
15
20
25

Figure 2

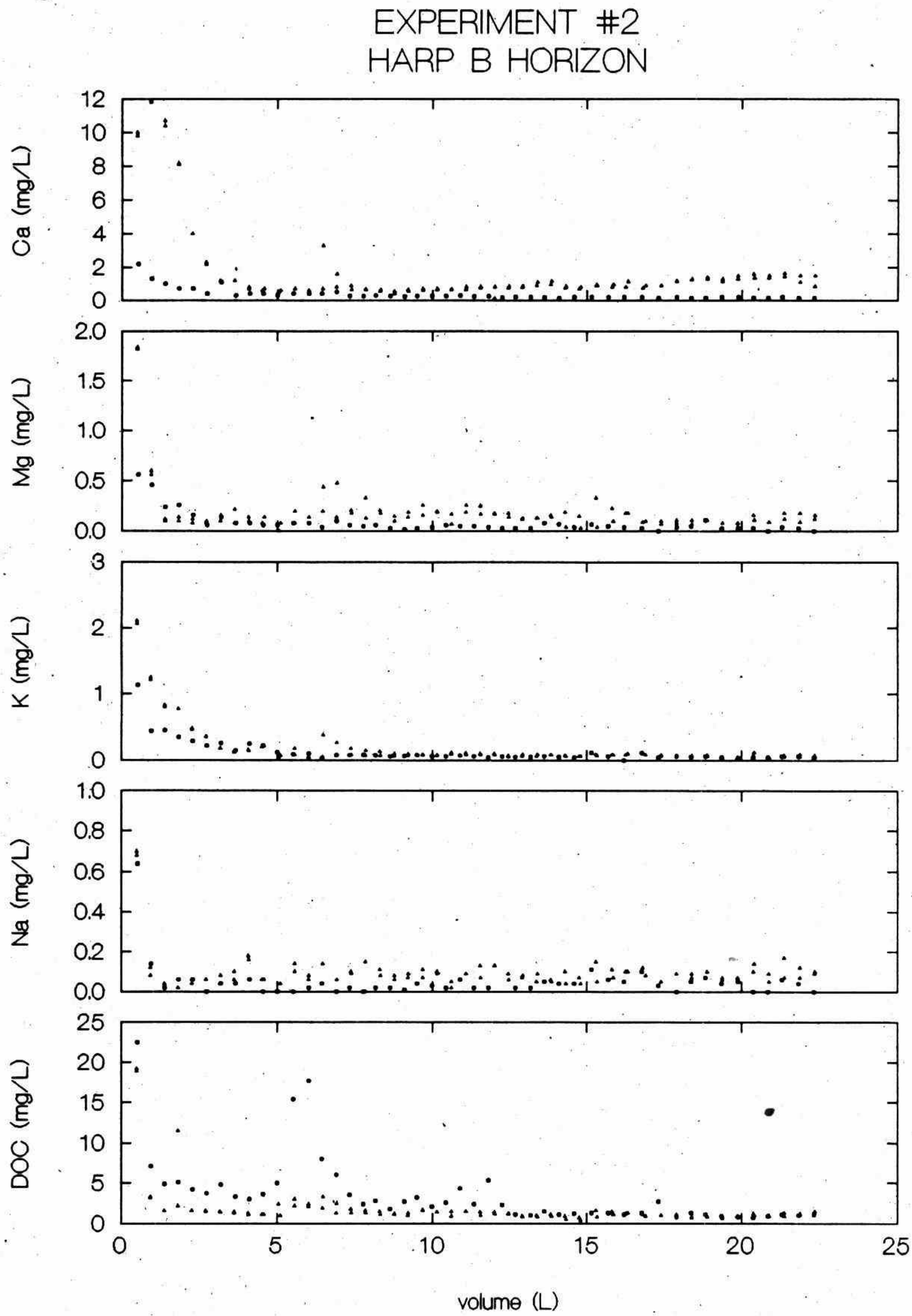

EXPERIMENT #2
HARP B HORIZON
Ca (mg/L)
12
10
8
6
4
2
0
Mg (mg/L)
2.0
1.5
1.0
0.5
0.0
K (mg/L)
3
2
1
0
Na (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
DOC (mg/L)
25
20
15
10
5
0
0
5
10
15
20
25
volume (L)

Figure 2

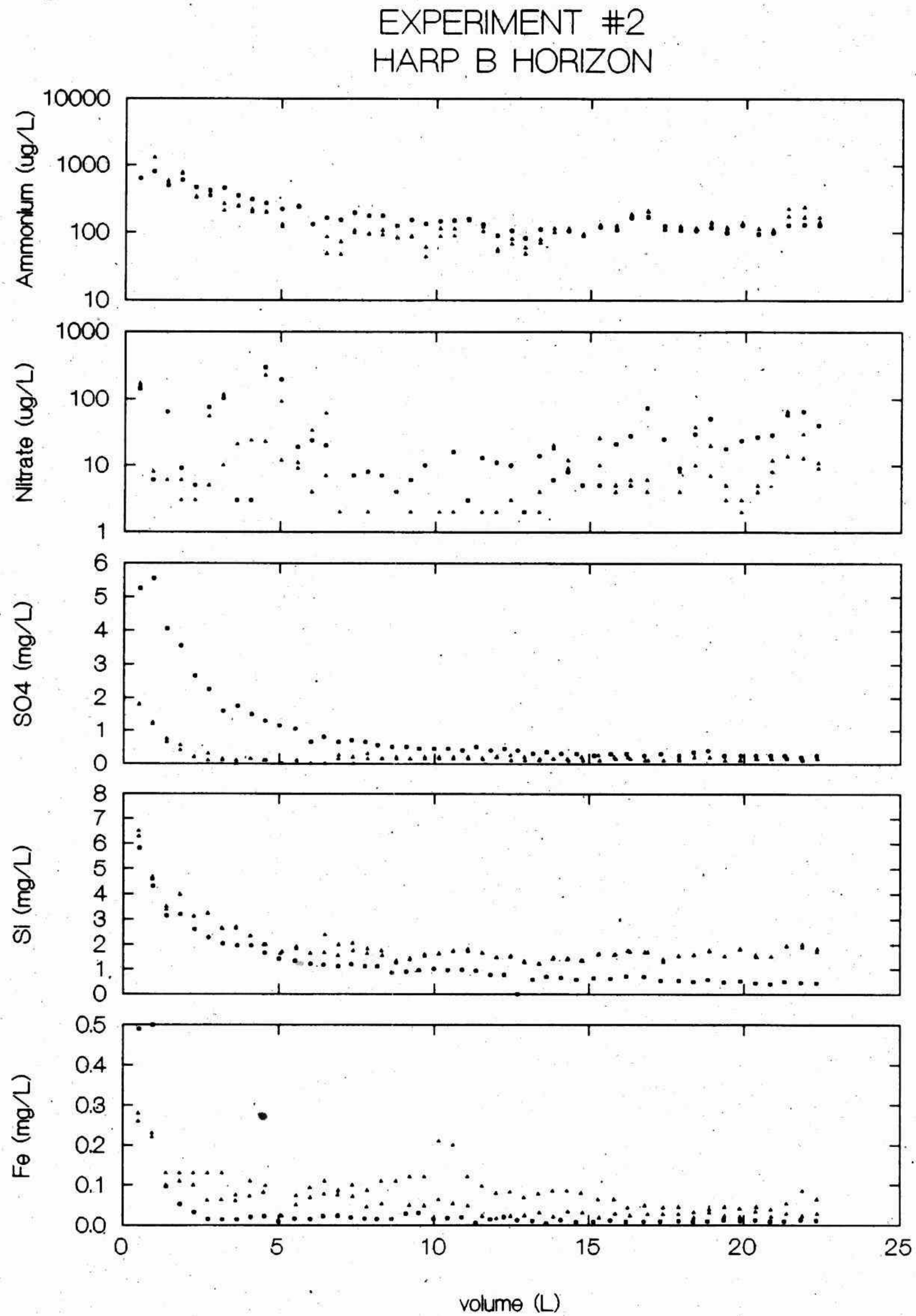

EXPERIMENT #2
HARP B HORIZON
Ammonium (ug/L)
10000
1000
100
10
Nitrate (ug/L)
1000
100
10
1
SO4 (mg/L)
6
5
4
3
2
1
0
SI (mg/L)
8
7
6
5
4
3
2
1
0
Fe (mg/L)
0.5
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
25
volume (L)

Figure 2

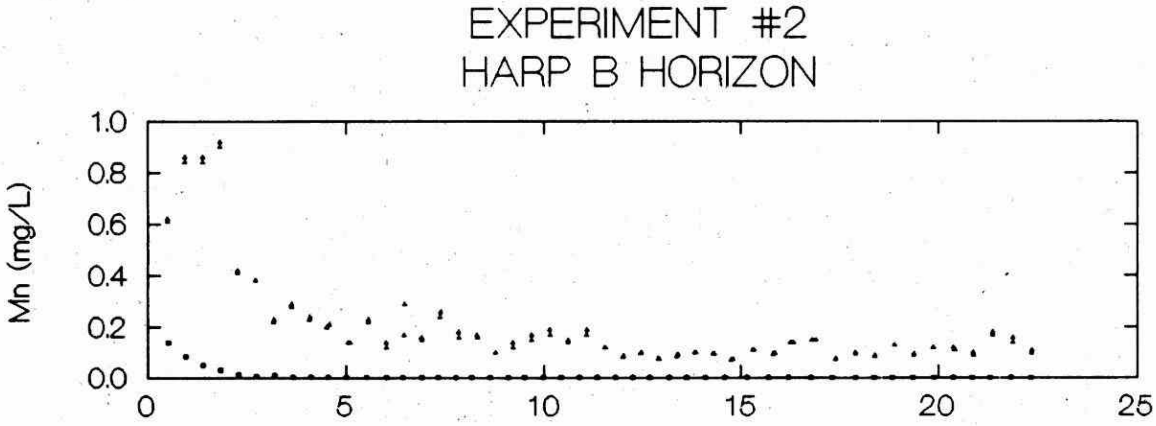
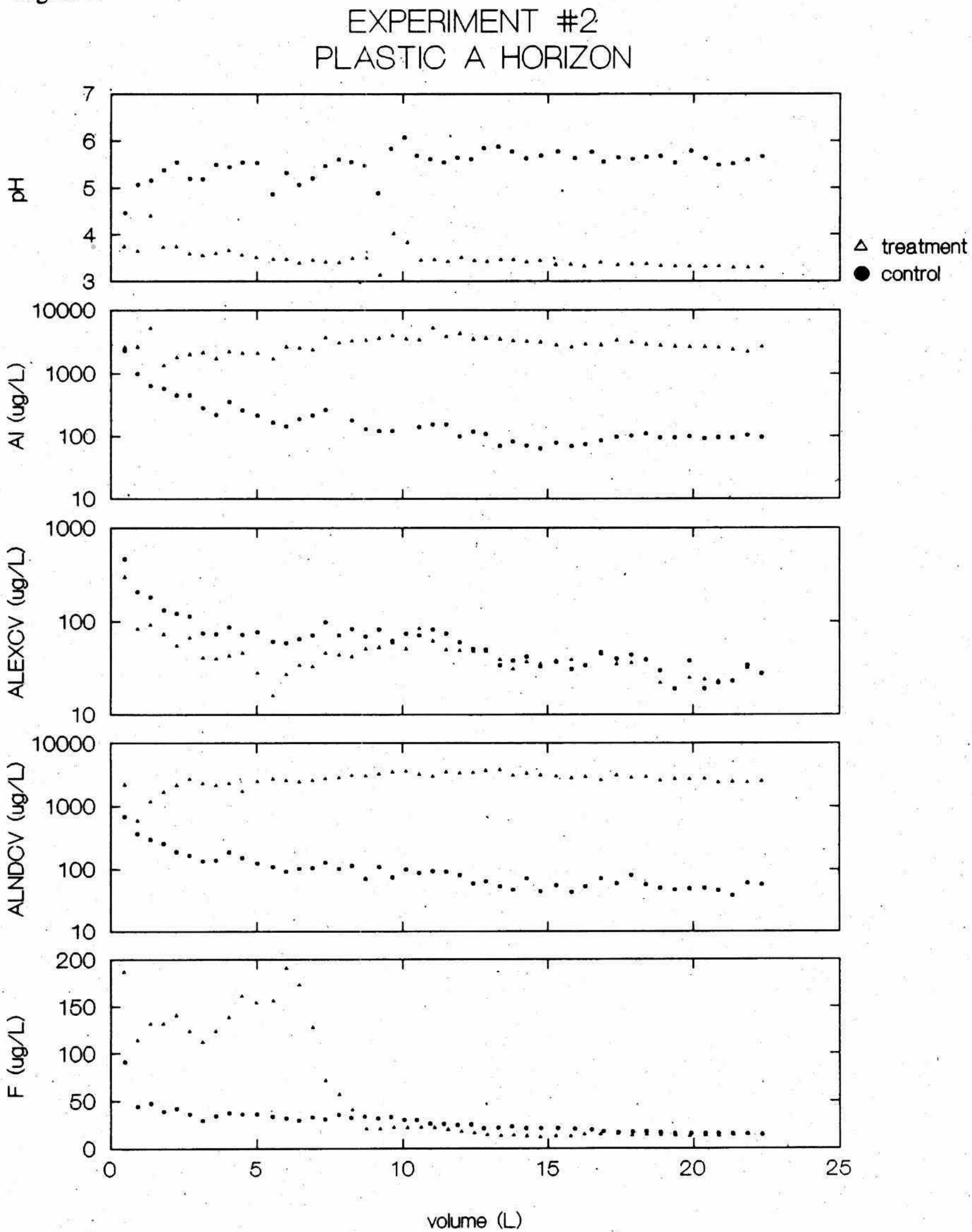

EXPERIMENT #2
HARP B HORIZON
Mn (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25

Figure 2



EXPERIMENT #2
PLASTIC A HORIZON
pH
Al (ug/L)
ALEXCV (ug/L)
ALNDCV (ug/L)
F (ug/L)
volume (L)
treatment
control
7
6
5
4
3
10000
1000
100
10
0
50
150
200
5
15
20
25

Figure 2

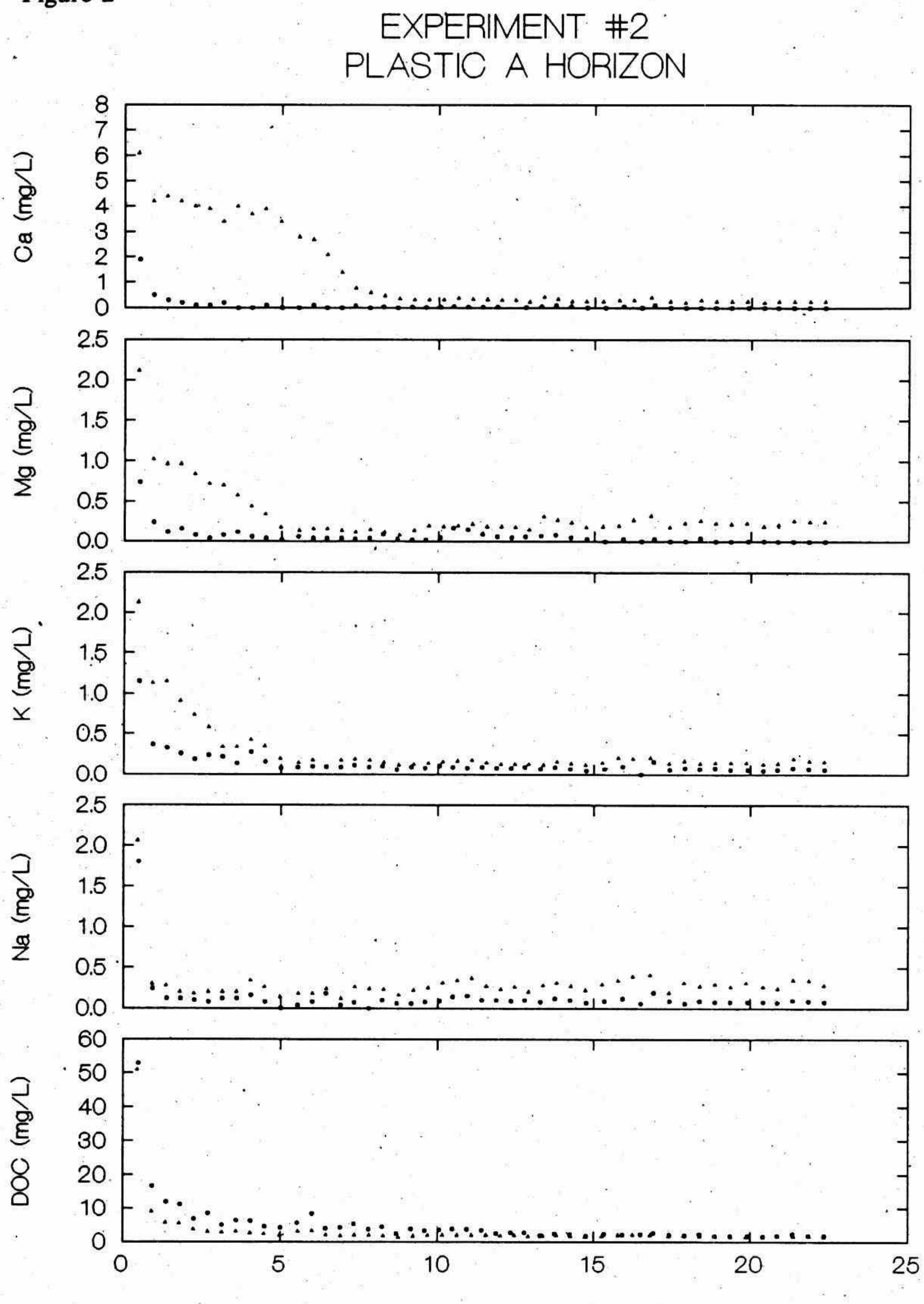

EXPERIMENT #2
PLASTIC A HORIZON
Ca (mg/L)
Mg (mg/L)
K (mg/L)
Na (mg/L)
DOC (mg/L)
volume (L)
0
5
10
15
20
25

Figure 2

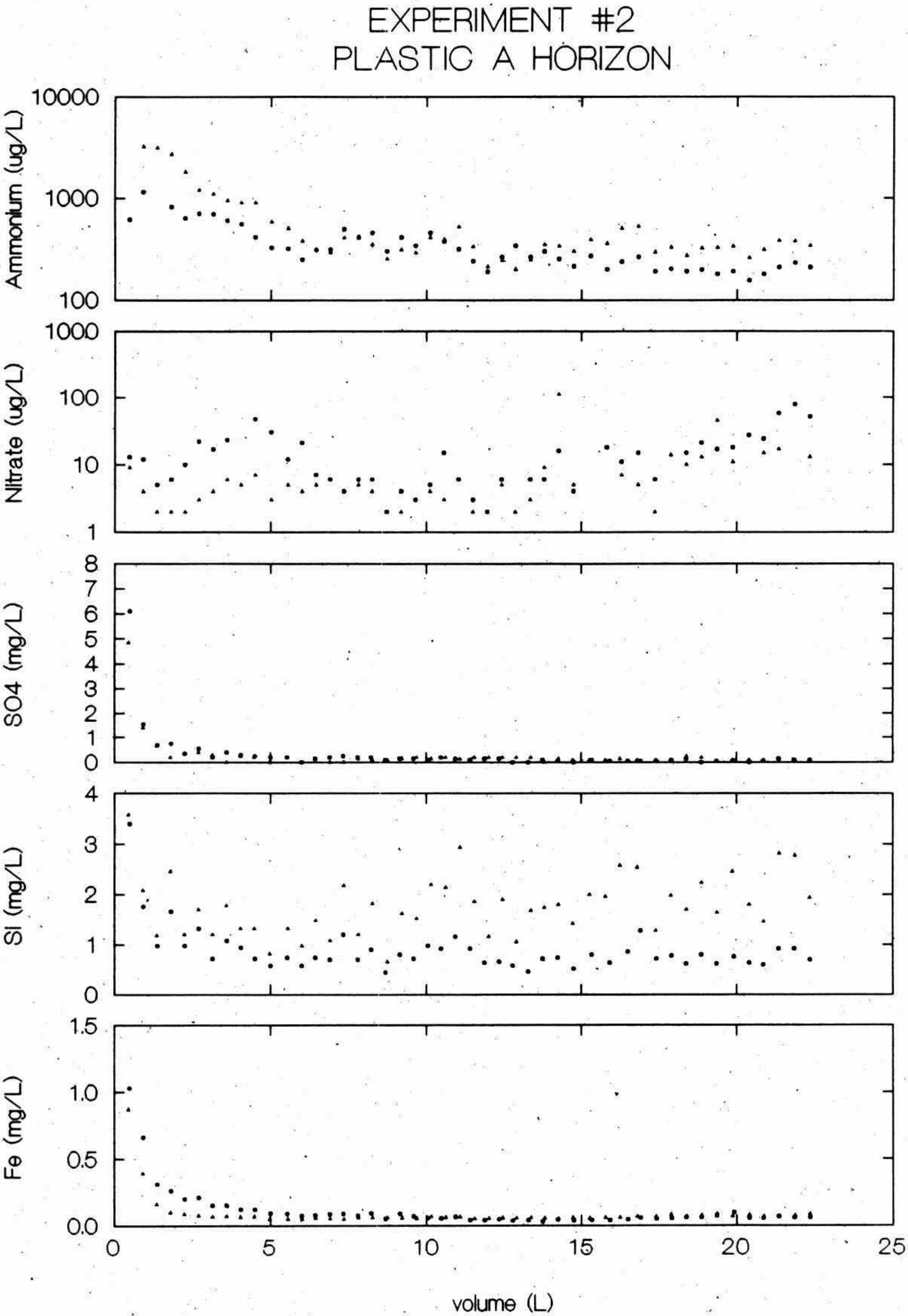

EXPERIMENT #2
PLASTIC A HORIZON
Ammonium (ug/L)
10000
1000
100
Nitrate (ug/L)
1000
100
10
1
SO4 (mg/L)
8
7
6
5
4
3
2
1
0
SI (mg/L)
4
3
2
1
0
Fe (mg/L)
1.5
1.0
0.5
0.0
0
5
10
15
20
25
volume (L)

Figure 2

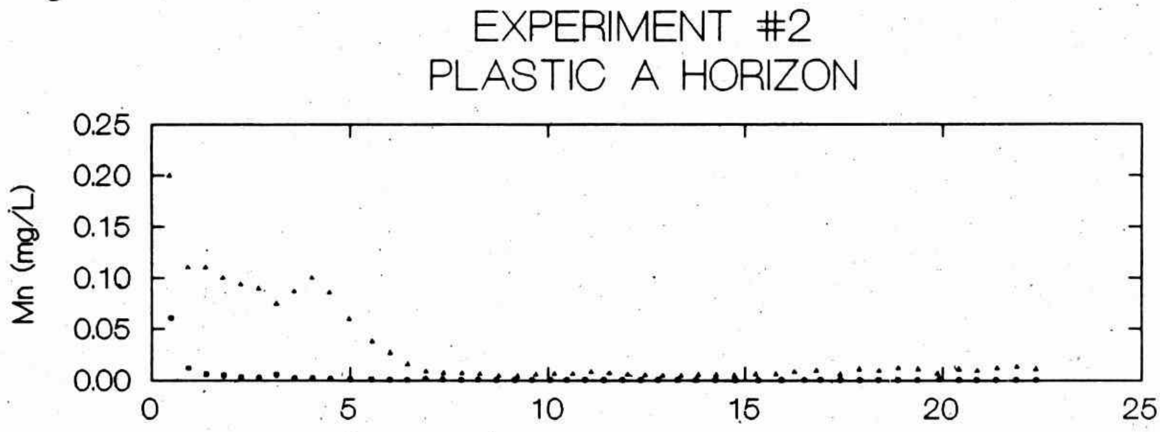

EXPERIMENT #2
PLASTIC A HORIZON
0.25
0.20
0.15
0.10
0.05
0.00
Mn (mg/L)
0
5
10
15
20
25

Figure 2

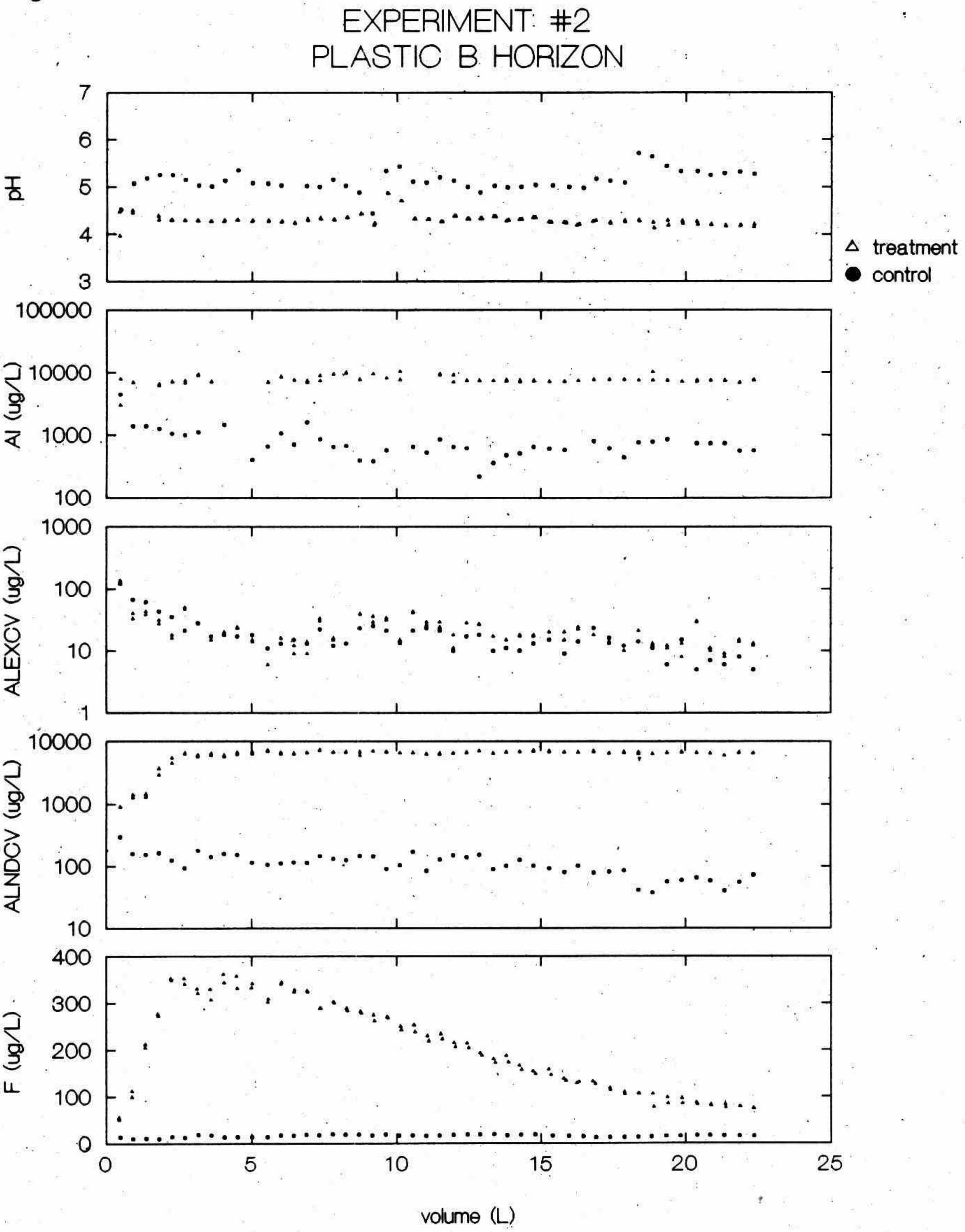

EXPERIMENT #2
PLASTIC B HORIZON
pH
Al (ug/L)
ALEXCV (ug/L)
ALNDCV (ug/L)
F (ug/L)
volume (L)
treatment
control
0
5
10
15
20
25

Figure 2

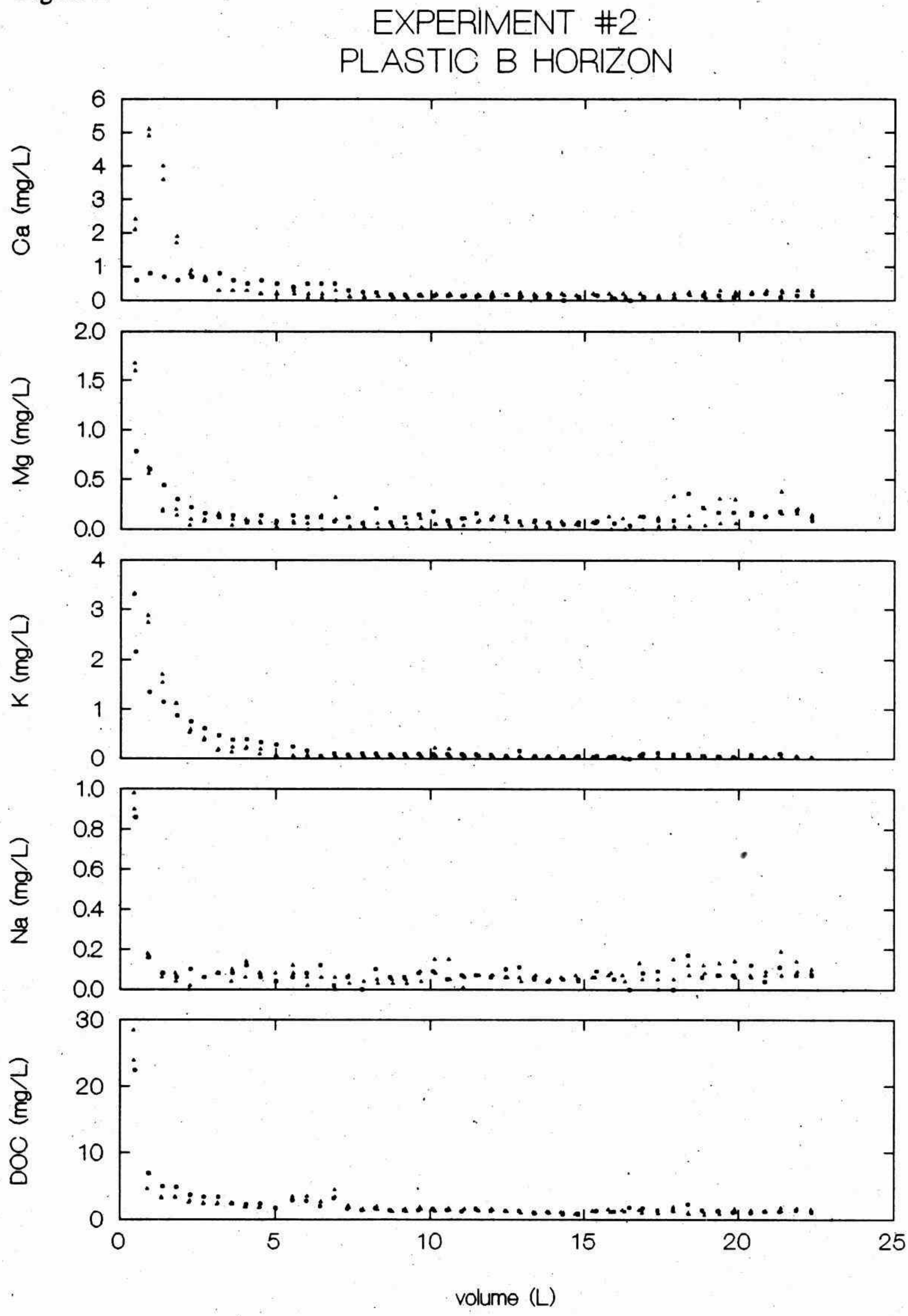
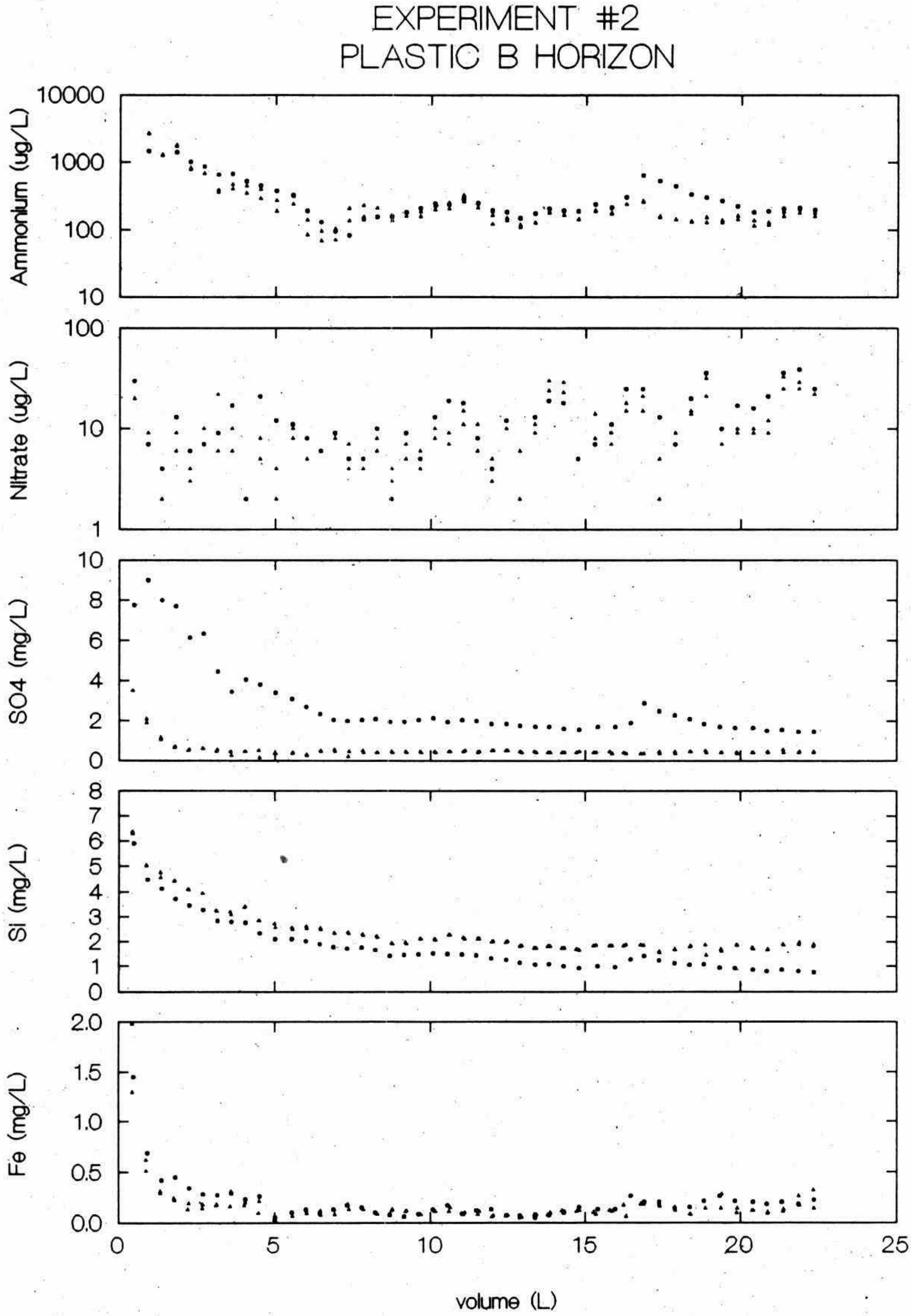

EXPERIMENT #2
PLASTIC B HORIZON
Ca (mg/L)
Mg (mg/L)
K (mg/L)
Na (mg/L)
DOC (mg/L)
volume (L)

Figure 2



EXPERIMENT #2
PLASTIC B HORIZON
Ammonium (ug/L)
10000
1000
100
10
Nitrate (ug/L)
100
10
1
SO4 (mg/L)
10
8
6
4
2
0
SI (mg/L)
8
7
6
5
4
3
2
1
0
Fe (mg/L)
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
volume (L)

Figure 2

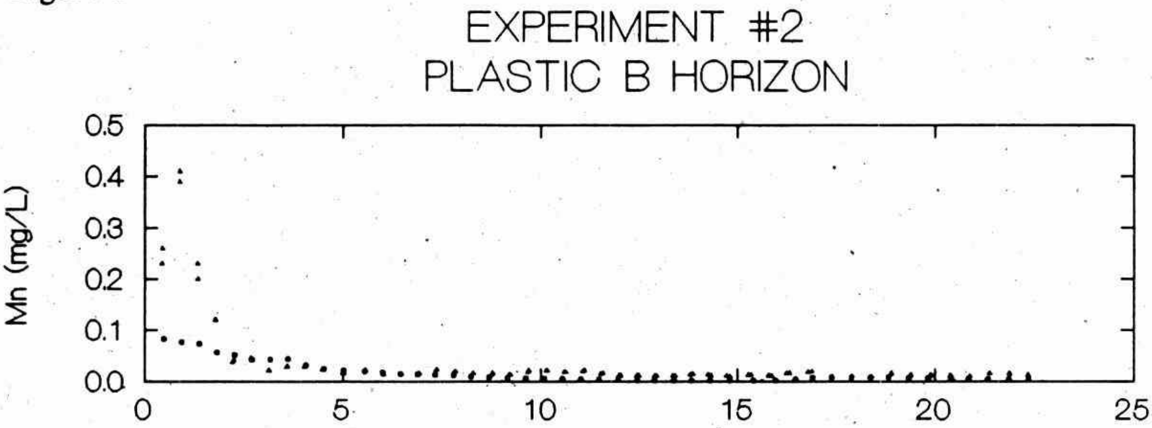
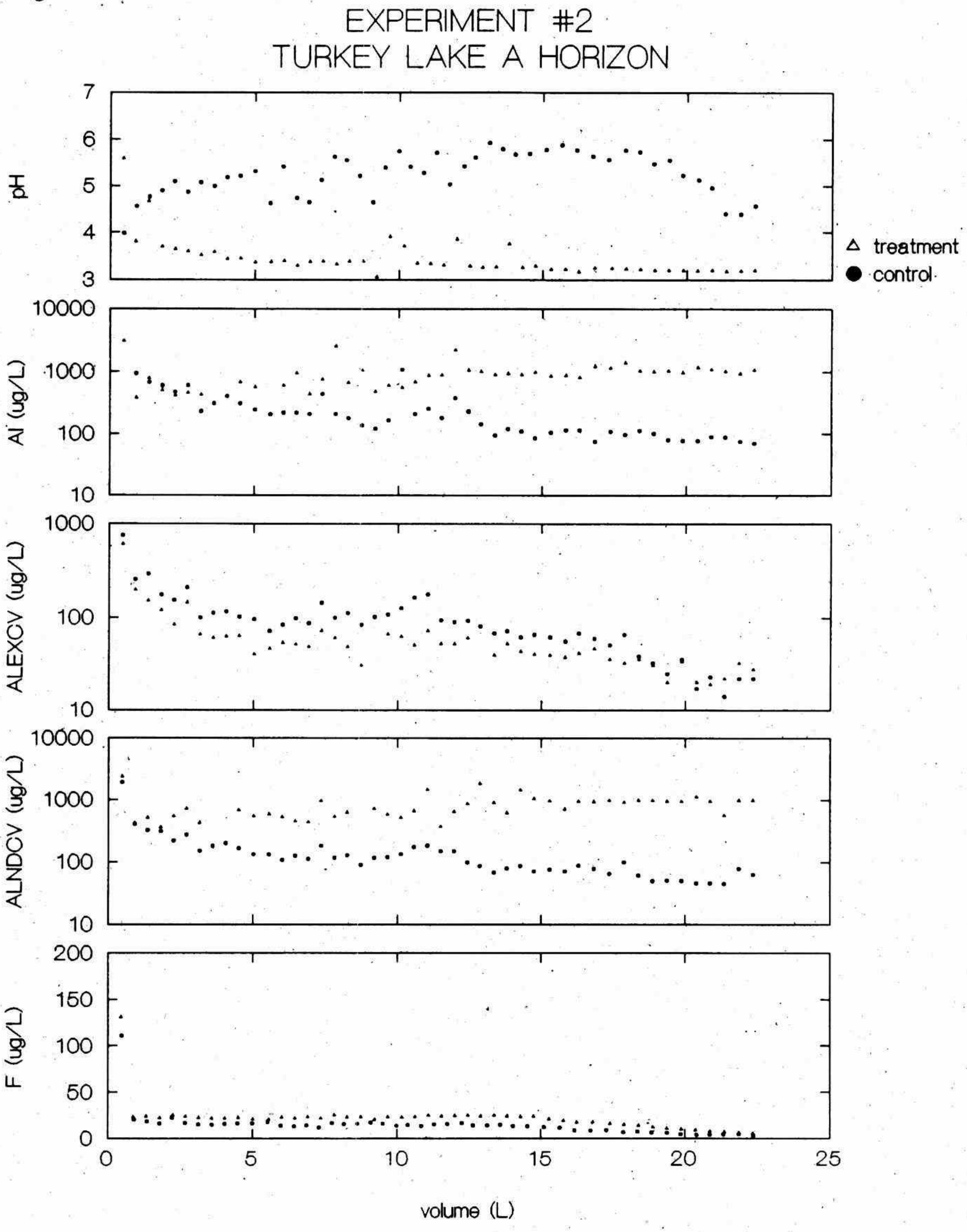

EXPERIMENT #2
PLASTIC B HORIZON
Mn (mg/L)
0.5
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
25

Figure 2



EXPERIMENT #2
TURKEY LAKE A HORIZON
pH
Al (ug/L)
ALEXCV (ug/L)
ALNDCV (ug/L)
F (ug/L)
volume (L)
treatment
control

Figure 2

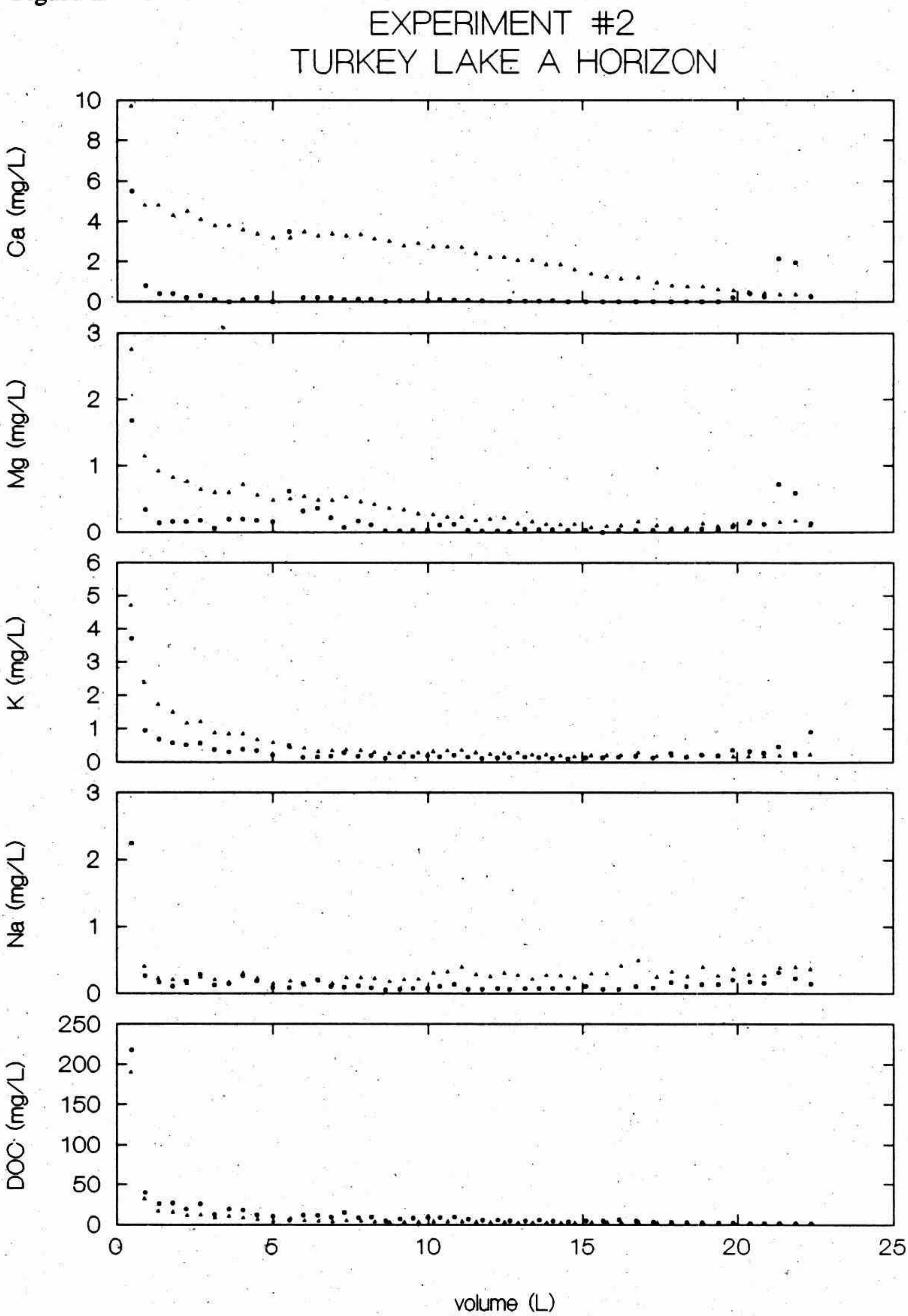

EXPERIMENT #2
TURKEY LAKE A HORIZON
Ca (mg/L)
Mg (mg/L)
K (mg/L)
Na (mg/L)
DOC (mg/L)
volume (L)
0
5
10
15
20
25

Figure 2

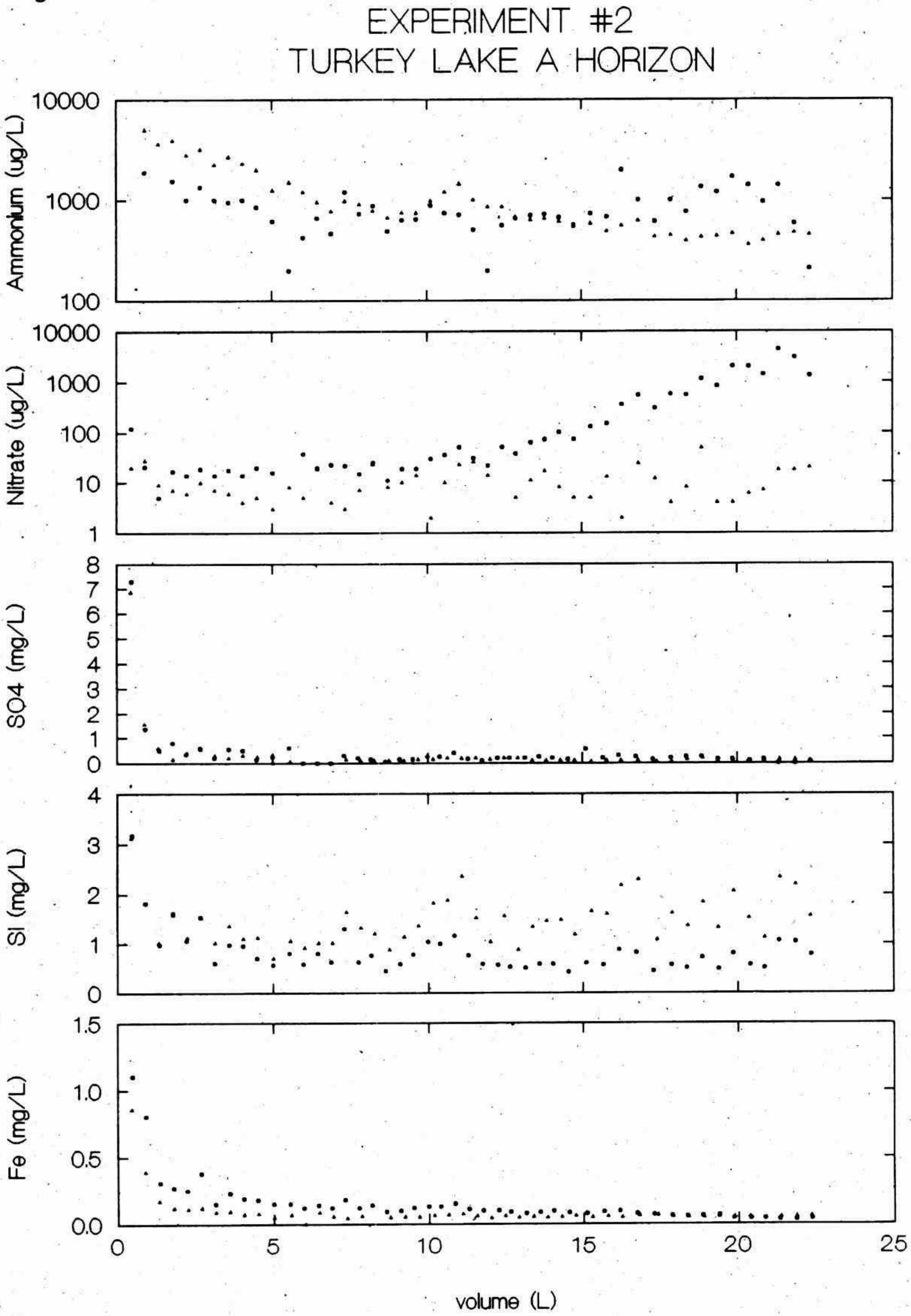

EXPERIMENT #2
TURKEY LAKE A HORIZON
Ammonium (ug/L)
10000
1000
100
Nitrate (ug/L)
10000
1000
100
10
1
SO4 (mg/L)
8
7
6
5
4
3
2
1
0
Si (mg/L)
4
3
2
1
0
Fe (mg/L)
1.5
1.0
0.5
0.0
0
5
10
15
20
25
volume (L)

Figure 2

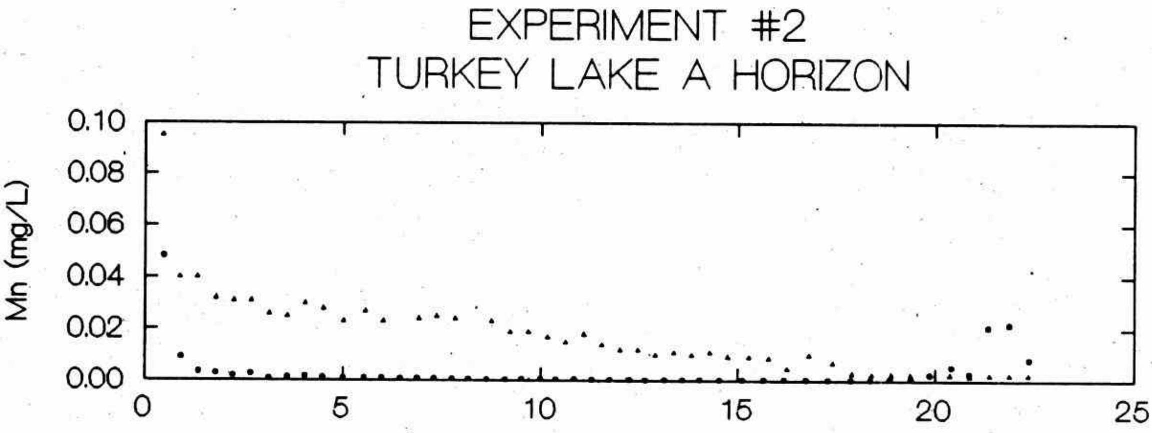

EXPERIMENT #2
TURKEY LAKE A HORIZON
Mn (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
0
5
10
15
20
25

Figure 2

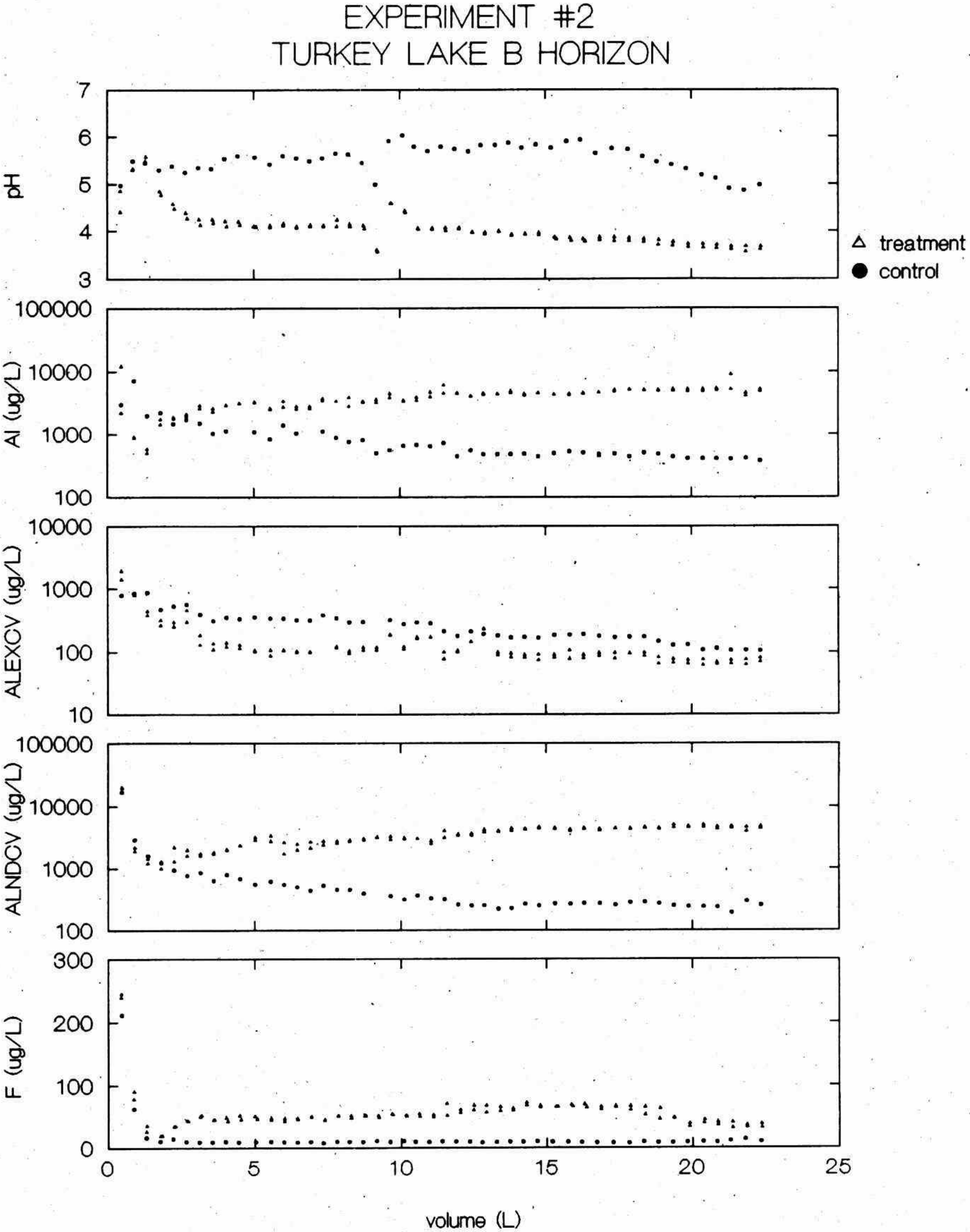

EXPERIMENT #2
TURKEY LAKE B HORIZON
pH
Al (ug/L)
ALEXCV (ug/L)
ALNDCV (ug/L)
F (ug/L)
volume (L)
treatment
control

Figure 2

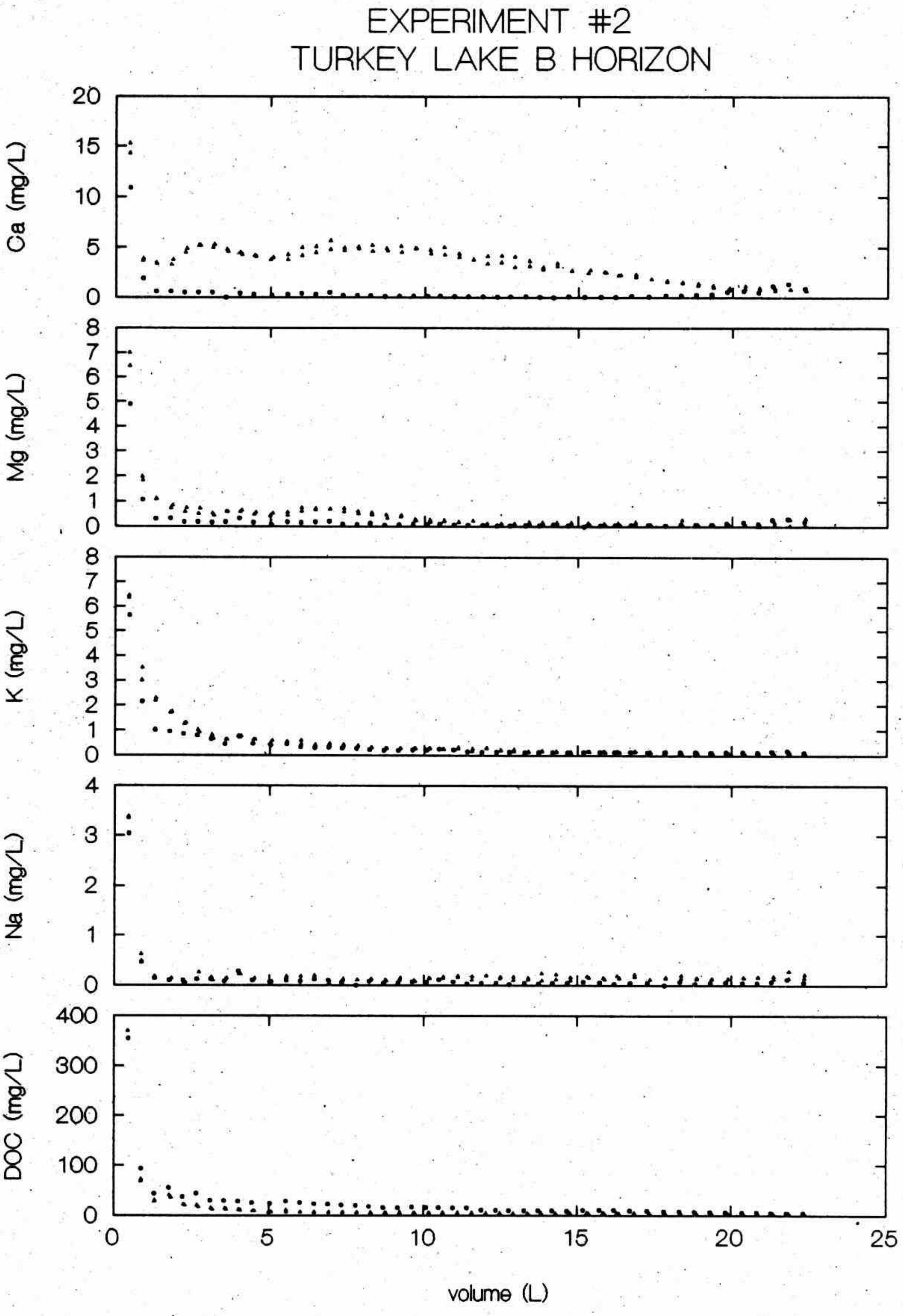
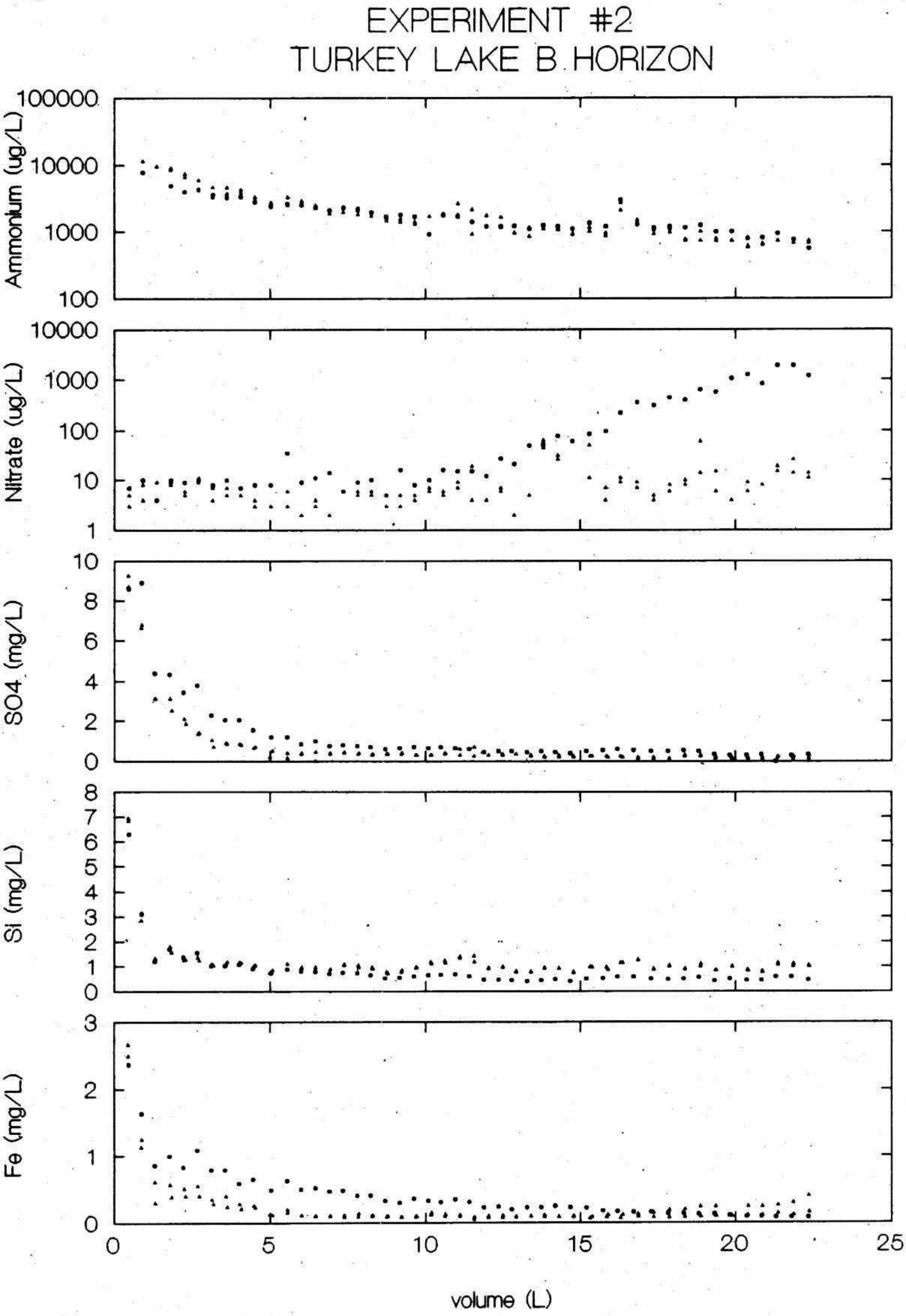

EXPERIMENT #2
TURKEY LAKE B HORIZON
Ca (mg/L)
Mg (mg/L)
K (mg/L)
Na (mg/L)
DOC (mg/L)
volume (L)
0
5
10
15
20
25

Figure 2



EXPERIMENT #2
TURKEY LAKE B HORIZON
Ammonium (ug/L)
100000
10000
1000
100
Nitrate (ug/L)
10000
1000
100
10
1
SO4 (mg/L)
10
8
6
4
2
0
Si (mg/L)
8
7
6
5
4
3
2
1
0
Fe (mg/L)
3
2
1
0
0
5
10
15
20
25
volume (L)

Figure 2

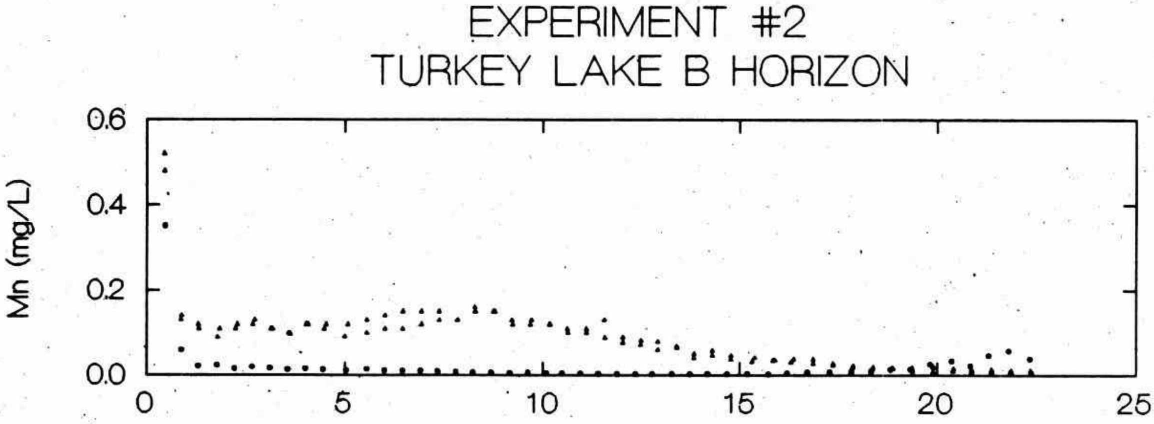

EXPERIMENT #2
TURKEY LAKE B HORIZON
0.6
0.4
0.2
0.0
Mn (mg/L)
0
5
10
15
20
25

Figure 2

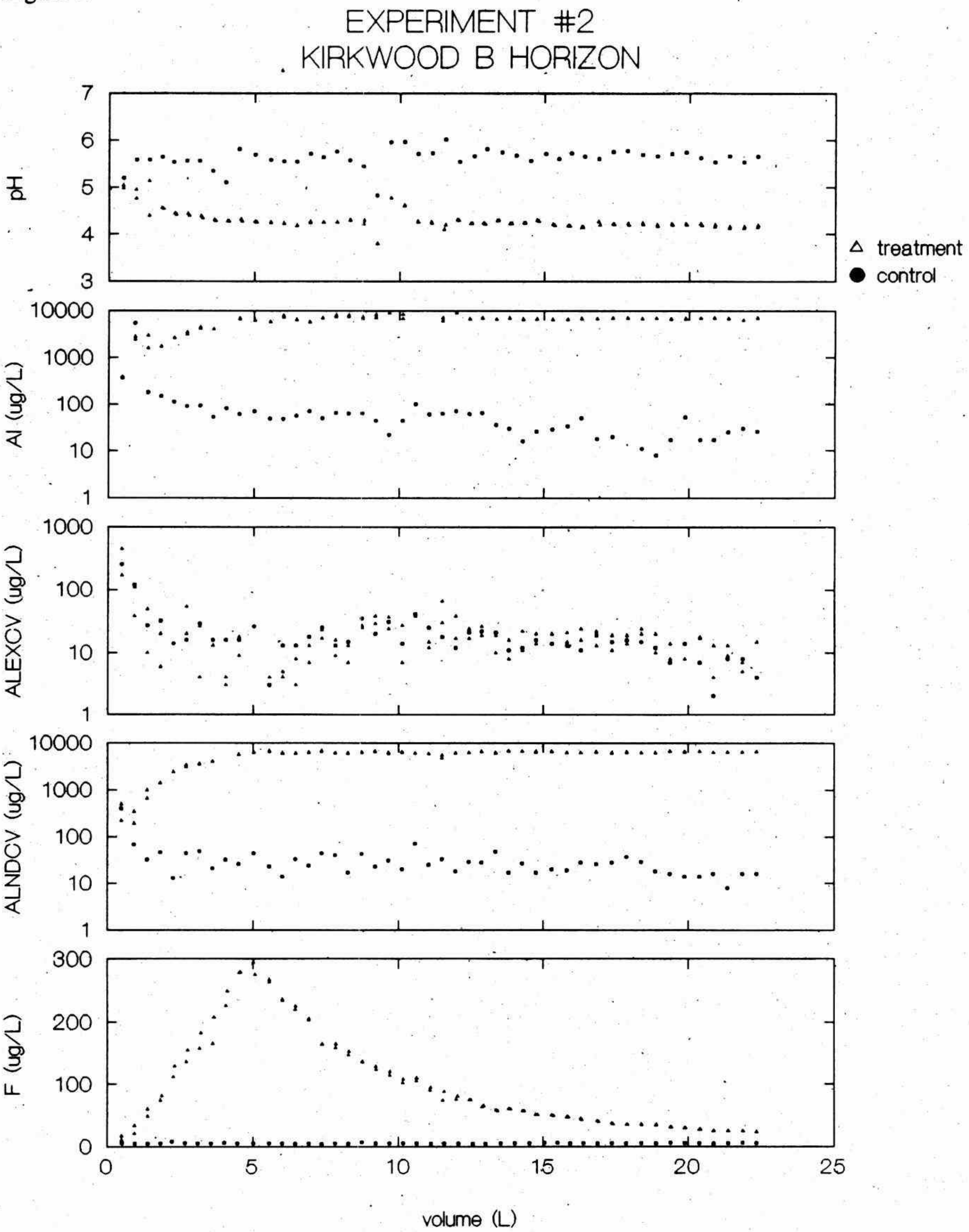

EXPERIMENT #2
KIRKWOOD B HORIZON
pH
Al (ug/L)
ALEXCV (ug/L)
ALNDCV (ug/L)
F (ug/L)
volume (L)
treatment
control
7
6
5
4
3
10000
1000
100
10
1
0
5
10
15
20
25
300
200

Figure 2

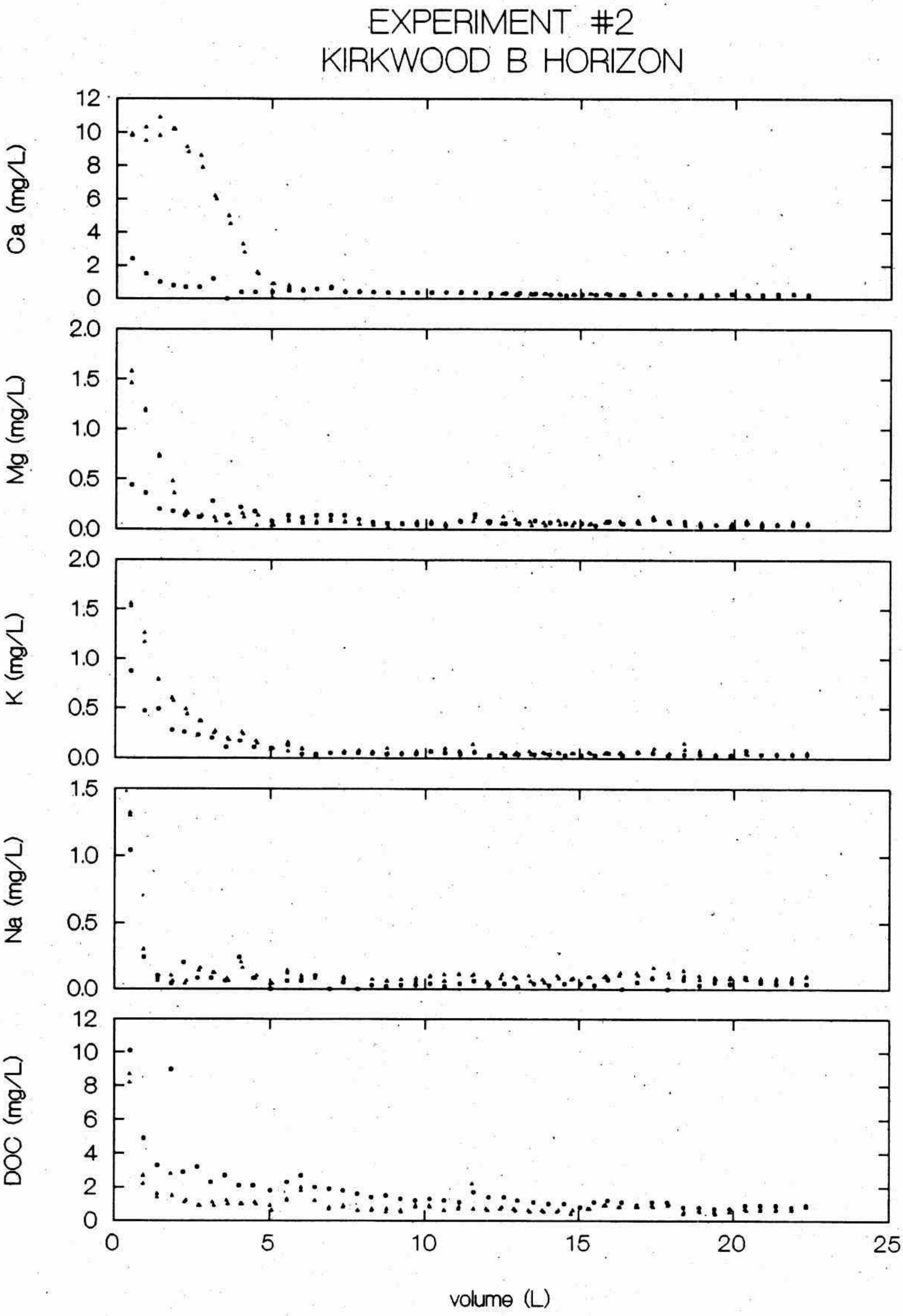
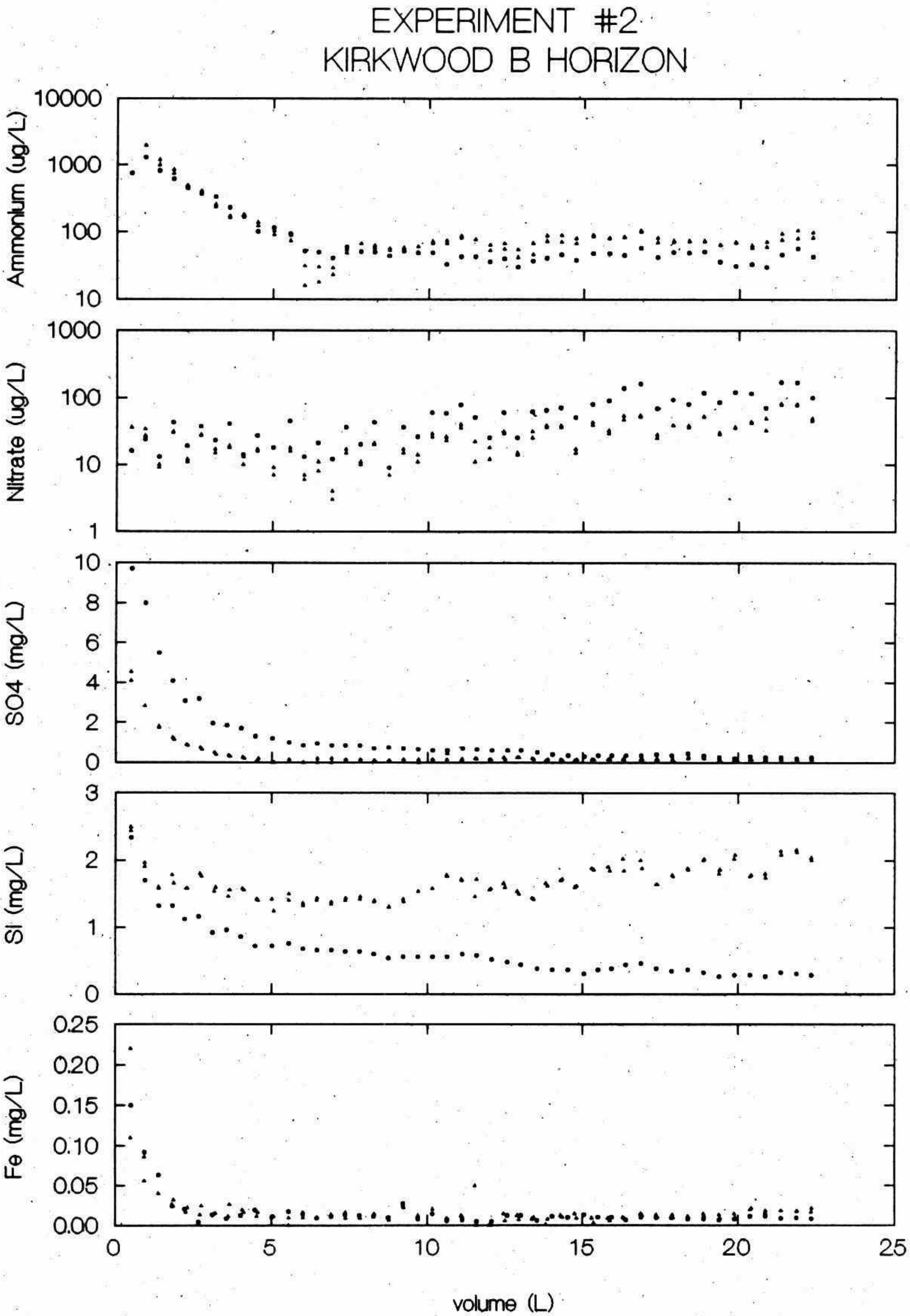

EXPERIMENT #2
KIRKWOOD B HORIZON
Ca (mg/L)
Mg (mg/L)
K (mg/L)
Na (mg/L)
DOC (mg/L)
volume (L)
0
5
10
15
20
25

Figure 2



EXPERIMENT #2
KIRKWOOD B HORIZON
Ammonium (ug/L)
10000
1000
100
10
Nitrate (ug/L)
1000
100
10
1
SO4 (mg/L)
10
8
6
4
2
0
Si (mg/L)
3
2
1
0
Fe (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
20
25
volume (L)

Figure 2

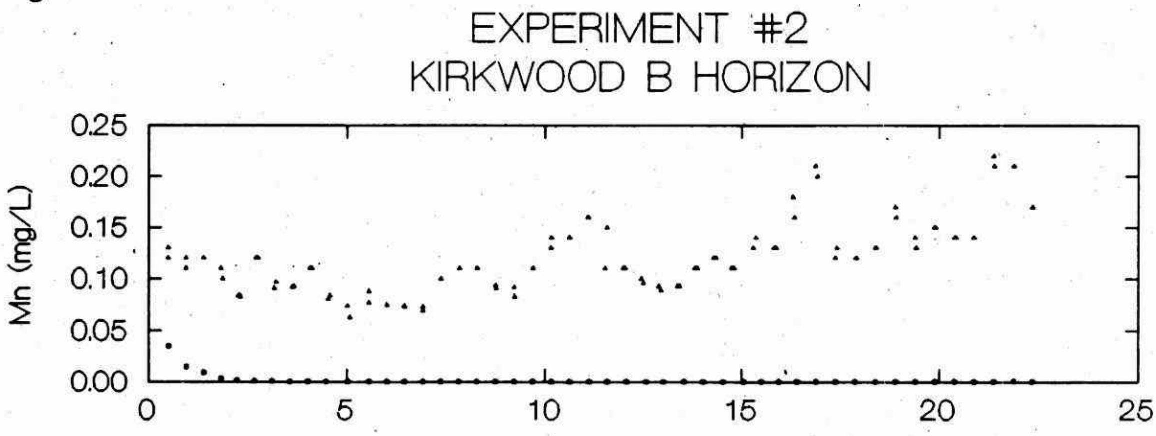

EXPERIMENT #2
KIRKWOOD B HORIZON
Mn (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
20
25

Figure 2

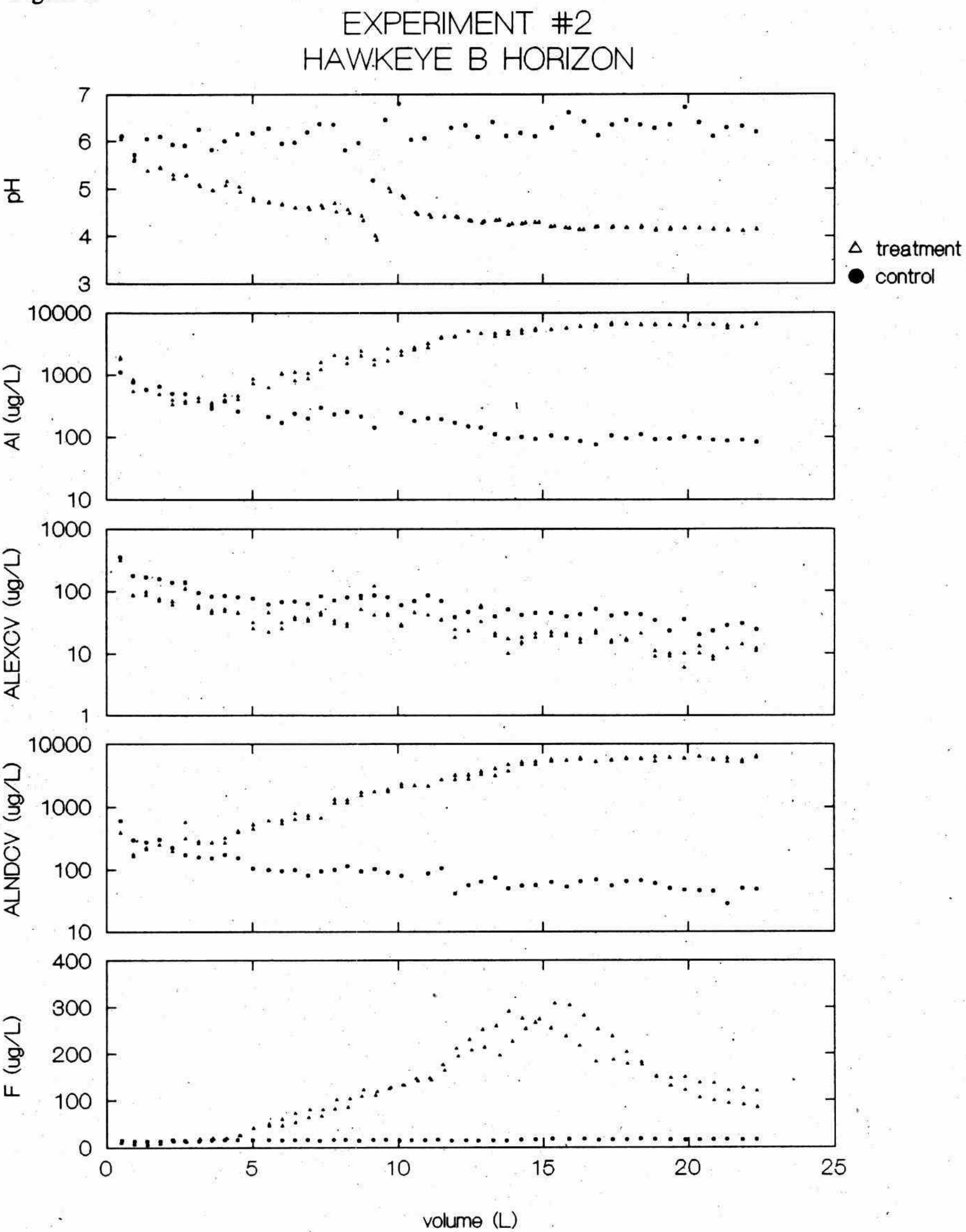
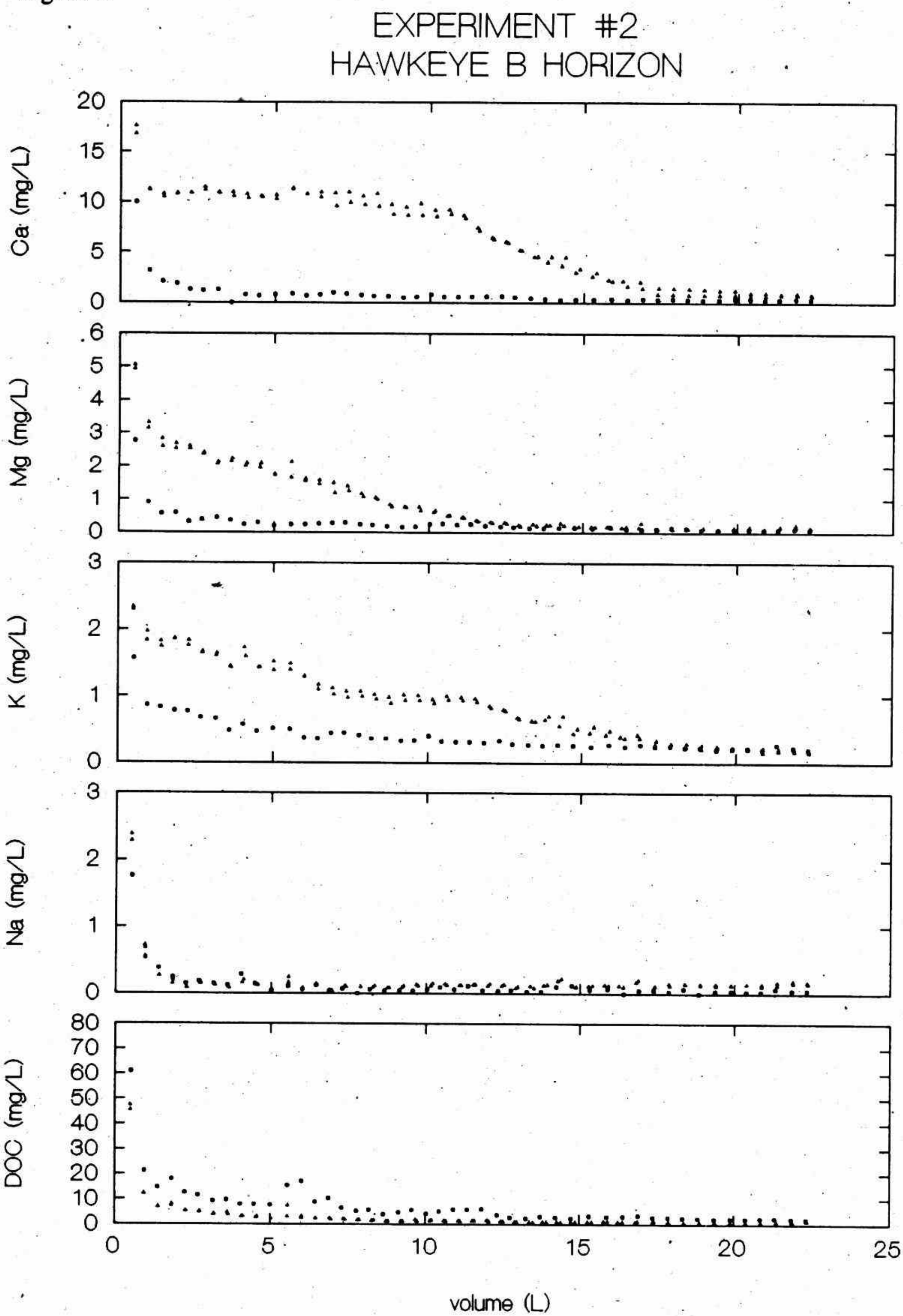

EXPERIMENT #2
HAWKEYE B HORIZON
pH
Al (ug/L)
ALEXCV (ug/L)
ALNDCV (ug/L)
F (ug/L)
volume (L)
△ treatment
● control
7
6
5
4
3
10000
1000
100
10
1
400
300
200
0
0
5
10
15
20
25

Figure 2



EXPERIMENT #2
HAWKEYE B HORIZON
Ca (mg/L)
Mg (mg/L)
K (mg/L)
Na (mg/L)
DOC (mg/L)
volume (L)

Figure 2

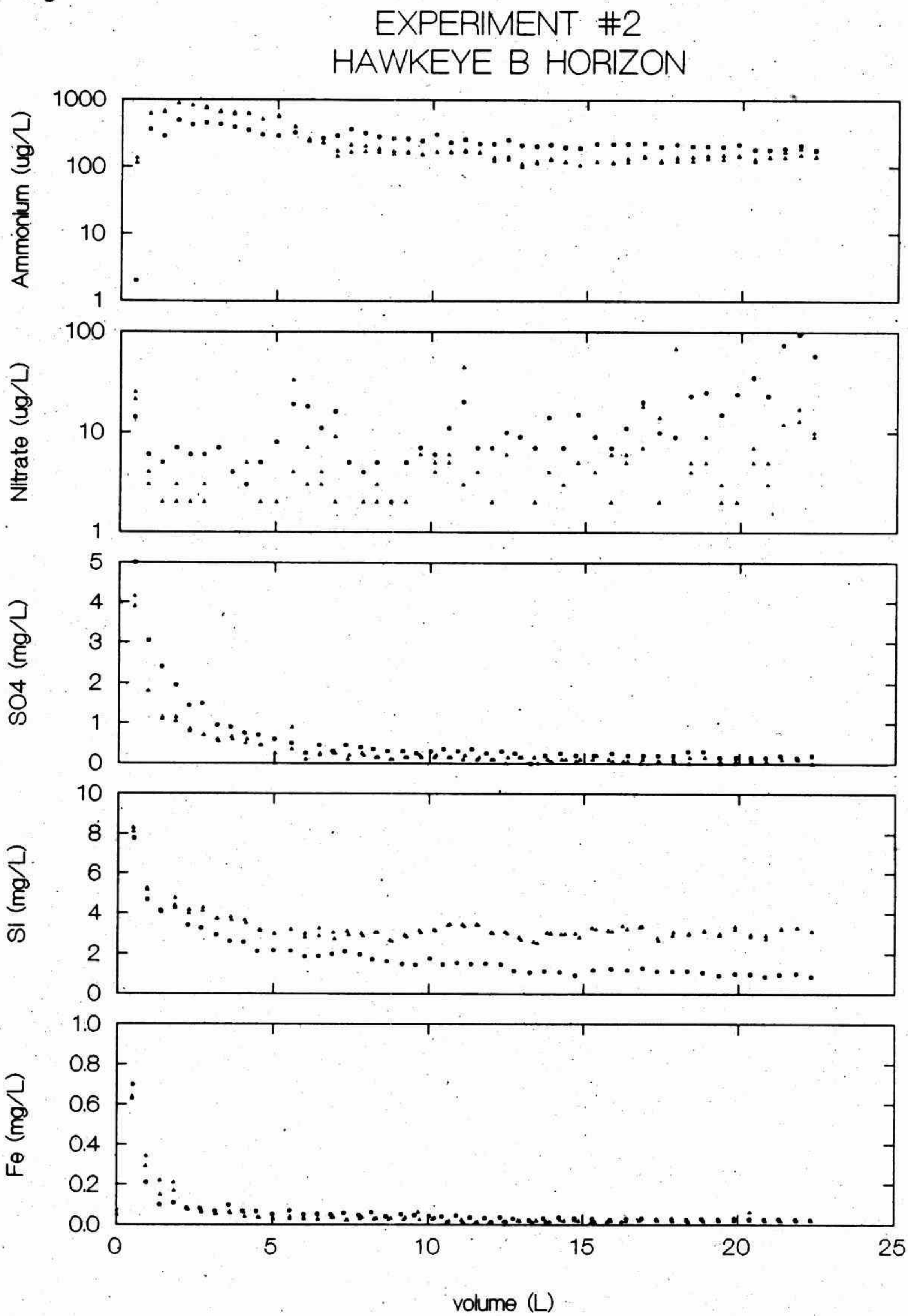

EXPERIMENT #2
HAWKEYE B HORIZON
Ammonium (ug/L)
1000
100
10
1
Nitrate (ug/L)
100
10
1
SO4 (mg/L)
5
4
3
2
1
0
Si (mg/L)
10
8
6
4
2
0
Fe (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
volume (L)

Figure 2

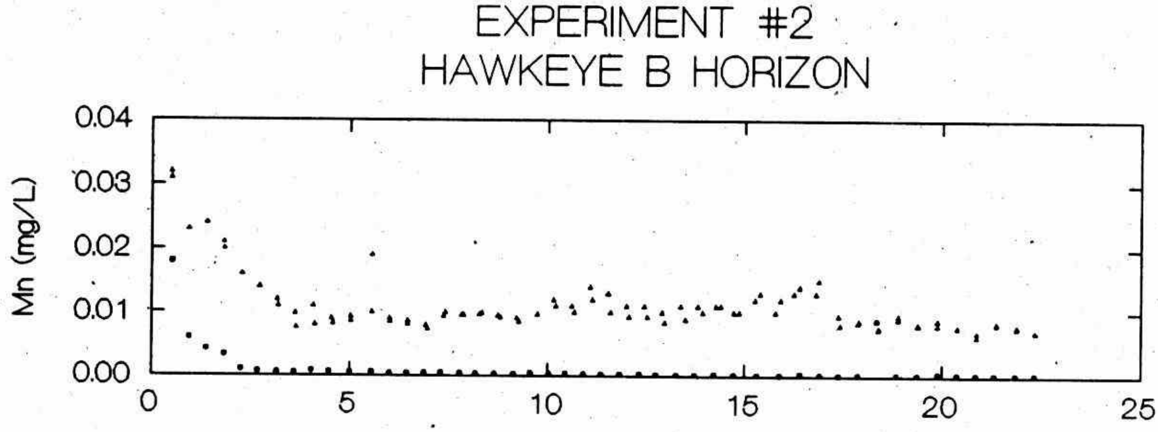

EXPERIMENT #2
HAWKEYE B HORIZON
Mn (mg/L)
0.04
0.03
0.02
0.01
0.00
0
5
10
15
20
25

Figure 3

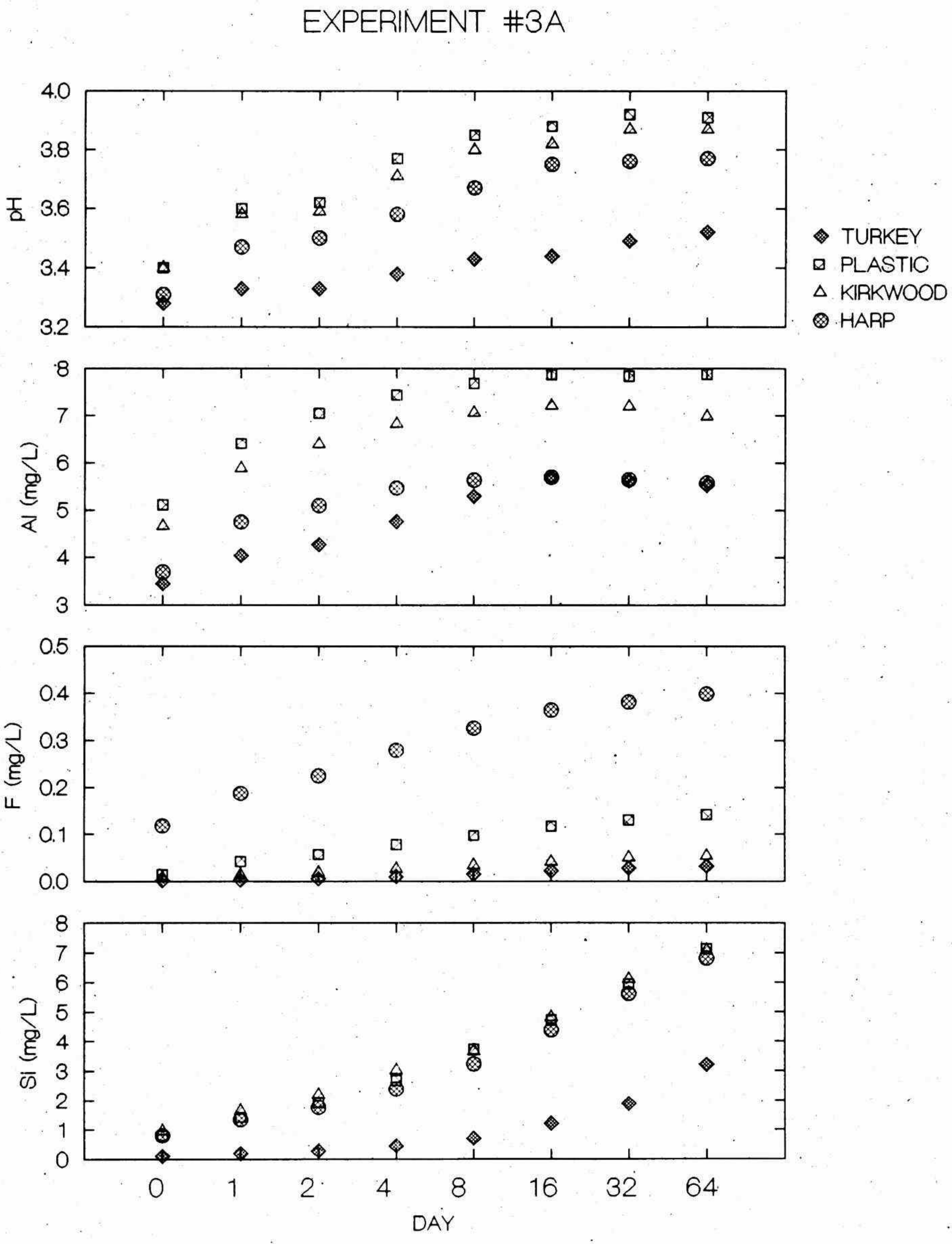
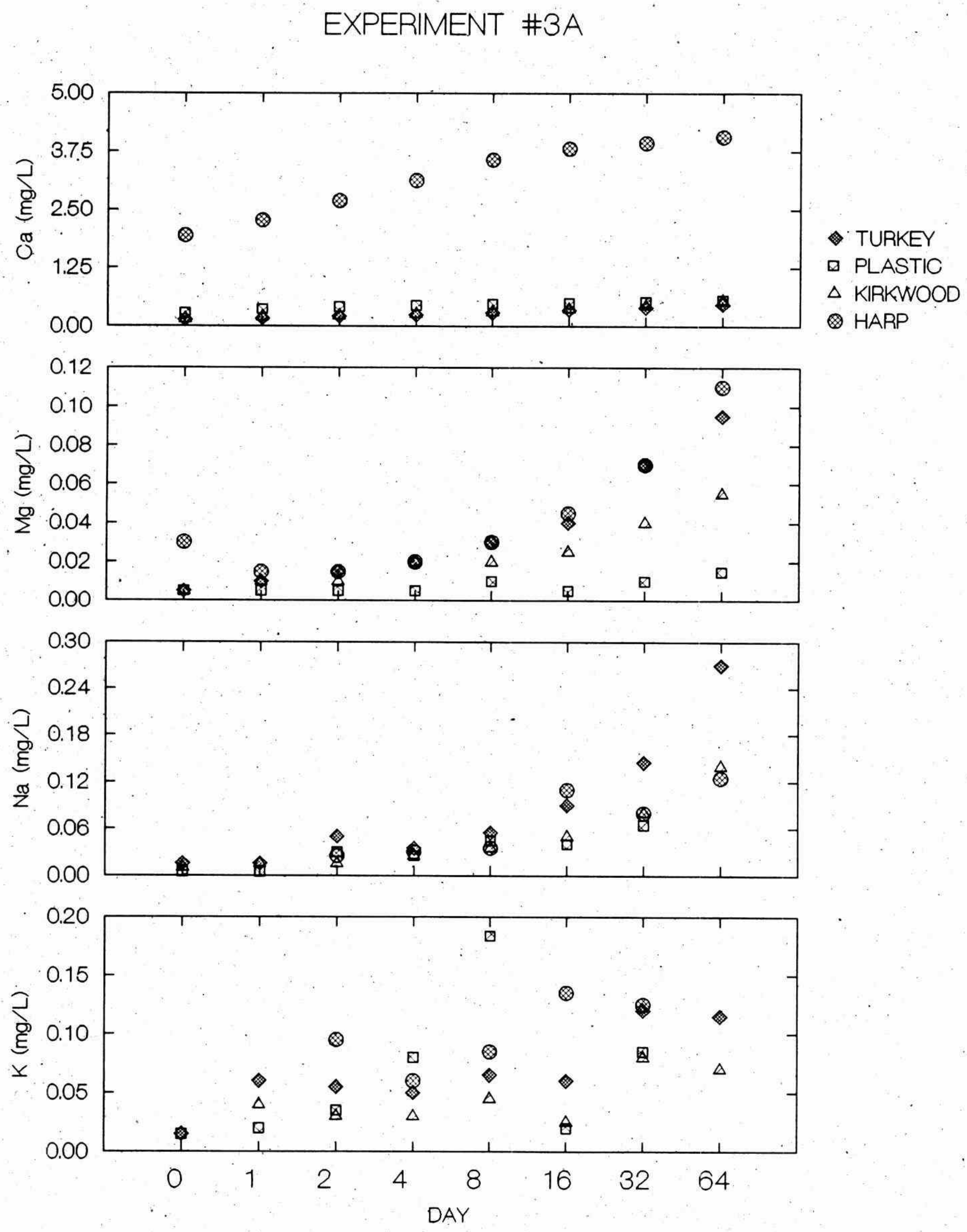

EXPERIMENT #3A
pH
4.0
3.8
3.6
3.4
3.2
TURKEY
PLASTIC
KIRKWOOD
HARP
Al (mg/L)
8
7
6
5
4
3
F (mg/L)
0.5
0.4
0.3
0.2
0.1
0.0
Si (mg/L)
8
7
6
5
4
3
2
1
0
0
1
2
4
8
16
32
64
DAY

Figure 3


EXPERIMENT #3A
Ca (mg/L)
5.00
3.75
2.50
1.25
0.00
Mg (mg/L)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Na (mg/L)
0.30
0.24
0.18
0.12
0.06
0.00
K (mg/L)
0.20
0.15
0.10
0.05
0.00
0
1
2
4
8
16
32
64
DAY
TURKEY
PLASTIC
KIRKWOOD
HARP